Water Resources in Jordan

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Acronyms

AGTP	Ain Ghazal Treatment Plant
BOD	Biological Oxygen Demand
BOT	Built Operate Transfer
CDM	Camp, Dresser, McKee International,
DAI	Development Alternatives Inc.
EHP	Environmental Health Project
FOE	Friends of the Environment
GCEP	General Corporation for Environmental Protection
GEF	Global Environmental Facility
GOJ	Government of Jordan
IR	Intermediate Result
JES	Jordan Environment Society
JICA	Japanese International Cooperation Agency
JRVSC	Jordan Rift Valley Steering Committee
JVA	Jordan Valley Authority
KAC	King Abdullah Canal
KFW	Kerditansalt für Wiederaufbau
KTD	King Talal Dam
MC	Management Contract
MCM	Million Cubic Meter
MOA	Ministry Of Agriculture
MOH	Ministry of Health
MOP	Ministry of Planning
MWI	Ministry of Water and Irrigation
NGO	Non Governmental Organization
PBWRC	Princess Basma Women's Resource Center
PMU	Program Management Unit
PSP	Private Sector Participation
RSCN	Royal Society for the Conservation of Nature
SO	Strategic Objective
TA	Technical Assistance
UFW	Unaccounted for Water
UNDP	United Nations Development Programm
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
WAJ	Water Authority of Jordan
WQIC	Water Quality Improvement and Conservation
WSP	Water Stabilization Ponds

PART I

THE WATER SECTOR

Institutional Setting of the Public Sector

Non-Governmental Organizations

Precipitation and Evaporation

Surface Water

Groundwater

Wastewater

Water Uses

Institutional Setting of the Public Sector

Ministry of Water and Irrigation

In 1988, the Ministry of Water and Irrigation (MWI) was created bringing The Water Authority of Jordan (WAJ) and the Jordan Valley Authority (JVA) under one umbrella.

MWI, WAJ and JVA each has an independent Secretary General who reports directly to the Minister of Water and Irrigation. The Ministry does not have authorizing Parliamentary legislation, but operates under a set of bylaws approved by the executive branch.

The main tasks of the MWI are: analyzing and formulating water policy; undertaking strategic planning and resource development programs; formulating water allocation options; establishing a water resource data bank and analyzing data; monitoring and controlling water quality.

The MWI is also the Ministry responsible to the Council of Ministers for implementing water-related matters in the Jordanian-Israeli Joint Water Committee (JWC), Water Working Group (WWG) in the Multi-laterals and the Jordan Rift Valley Steering Committee (JRVSC).

I. Water Authority of Jordan

The WAJ was created in 1984 as an independent body under the Prime Minister. In 1988, it was brought under the newly created MWI. WAJ is responsible for municipal and industrial water supplies and wastewater. It plans water and wastewater projects, implements and operates all water supply and wastewater facilities in Jordan, explores existing water resources, and maintains and operates water and wastewater networks throughout the Kingdom.

II. Jordan Valley Authority

The JVA was created in 1977. At the time JVA was charged with the social and economic development in the Jordan Rift Valley from the Yarmouk River in the north to Aqaba in the south. The eastern boundary of JVA's area of responsibility is located between the 300m and 500m contour lines above sea level.

In 2001, JVA's law was amended and under the new law JVA maintained the responsibility for the management of water and land resources in the valley as well as the responsibility for the touristic development of the Jordan Rift Valley.

Ministry of Planning

The Ministry of Planing (MOP) reviews MWI, WAJ and JVA plans for the water sector, the proposed projects, and the projects' proposals and feasibility. It then coordinates with donor and international financing agencies for funding of these projects.

Ministry of Finance

The Ministry of Finance (MOF) Budget Department oversees the allocation of budgets to the water sector in accordance with government rules and regulations. The Ministry is also involved in the finance of projects and the payment of local and international loans.

Ministry of Health

The Ministry of Health (MOH) monitors the suitability of the drinking water that is supplied by WAJ. MOH also monitors public and private wastewater facilities to assure its compliance with the prevailing standards and regulations.

Public Law No. 21 of 1971 and its articles provide the ministry with a wide range of powers to enforce the laws and regulations entrusted to it. Other regulations are issued in coordination between the MOH and the MWI to regulate the use of treated wastewater flows for irrigation.

Ministry of Agriculture

Agriculture Law No. 20 of 1973 authorizes the Ministry of Agriculture (MOA) to exploit surface water resources through construction and operation of small dams and other facilities for production of stock feed crops. It also empowers the Ministry to drill wells and equip them for provision of livestock water. Ultimately, MOA policies have a profound effect on the water resources of the country since they affect water policies as well as the planning and management of water resources. Affiliated with the MOA is the National Center for Agricultural Research and Technology Transfer.

Council of Ministers (Cabinet of Ministers)

The Council of Ministers is involved in the water sector in three functions: 1) policy, planning and management; 2) legislation, licensing and standards; 3) approval of projects' financing, and setting of water tariffs and other fees.

National Center for Agricultural Research and Technology Transfer (NCARTT)

Established in 1986 as a result of the reorganization of the Department of Agricultural Research and Extension within the MOA. Its mandate is coordinating all agricultural research and technology transfer activities within the Kingdom of Jordan.

Programs implemented by the Center include on-farm demonstrations and linkages with institutions engaged in agricultural extension are founded.

The General Corporation for Environmental Protection (GCEP)

The Corporation was established 1995 in response to the Jordan Environment Law No. 12, in a governmental attempt to unify and coordinate responsibilities and efforts being undertaken in the field of the environment. Accordingly, GCEP is the responsible body in Jordan that oversees the government's environmental policies. Before the establishment of the GCEP, those responsibilities were the mandate of the Department of Environment at the Ministry of Municipal, Rural and Environmental Affairs.

Royal Scientific Society, Environmental Research Center

Established in 1989, it comprises of three divisions: Water Quality, Air Quality, and Studies and Design.

The Water Quality division is responsible for conducting studies and research on contract basis to public and private entities. Correspondingly, it monitors groundwater and surface water resources for GCEP, WAJ and JVA and evaluates the performance of wastewater treatment plants. As the studies are conducted on behalf of another party, the results of the studies are the property of the contracting agency and RSS cannot publish or disseminate the information without prior approval.

Water and Environment Research & Study Center, University of Jordan

Founded by a Royal Decree in 1982 to contribute to the national efforts to develop and protect the water resources of the country. Recently the Center expanded its activities to deal with the environment and to protect its elements from degradation and pollution.

The Center is an independent unit that is directly linked to the President of the University. It has a water and environment laboratory that carries out required analysis as well as field equipment to carry out surveys and measurements of water discharge, salinity of water and soils, water hardness and others. Many research activities at the center are funded by donor agencies including USAID, EU, the French Government and the Dutch Government.

Queen Rania Al-Abdullah Center for Environmental Sciences & Technology, Jordan University for Science & Technology

Formally the Center for Environmental Sciences and Technology, was established in May 1996. The center, which is governed by a board of governors, aims to promote environmental awareness and environmentally informed policy and decision-making processes.

The Center developed formal curriculum in environmental science and engineering at graduate and undergraduate levels, and implements numerous work-specific training for managers and professionals in industrial, public sector and local governing councils. In addition, the center conducts applied research as well as integrated research on environmental needs and local problems identified by the private and public sectors.

Strategic Environment and Water Resources Research Unit, Al Al-Bayt University

Established in 1995, the Unit aims to redevelop water resources in the Badia in a sustainable manner including utilization of age-old methods such as water harvesting. To-date the unit has completed a rainfall forecast station in the Badia, conducted ground water quality analysis in Mafraq, and did a study on sediments transport. The Unit receives funding from UNISCO, MWI, World Bank and the British Council.

Institute of Land, Water and Environment (ILWE), Hashemite University

The Institute of Land, Water and Environment (ILWE) was established at the Hashemite University in 1999. The objective of the Institute is to involve the Hashemite University in the environmental issues facing the country, carry out research and studies on environmental problems facing Jordan and their solution, and build local capacity in the fields of environment and land management.

ILWE has three departments: 1) Department of Environmental and Earth Sciences, 2) Department of Land Management, and 3) Department of Environment and Water Management.

Inter-Islamic Network on Water Resources Development and Management (INWRDAM)

Established in 1987, INWRDAM is an inter-governmental, autonomous organization that operates under the umbrella of the Standing Committee on Scientific and Technological Cooperation of the Organization of the Islamic Conference (OIC). Since its establishment, INWRDAM is hosted in Amman by the Government of Jordan. Currently INWRDAM includes 15 OIC member states (Bangladesh, Egypt, Iraq, Jordan, Lebanon, Malaysia, Mali, Niger, Oman, Pakistan, Sudan, Syria, Tunisia, Turkey and Yemen). INWRDAM is specialized in the identification of water resources management and development programs for its members.

Non-Governmental Organizations Involved in Environment

Jordan Environment Society (JES)

JES was founded in 1988 to promote the protection of the environment and the sustainable use of natural and living resources. JES's mandate also stipulates that they will work towards the establishment of environmental laws and standards in Jordan, and towards raising the level of environmental awareness among all strata of the Jordanian Community to create new positive behavioral patterns towards the environment.

To-date, JES has implemented a national environmental information and education program, a water awareness program, an integrated pest management program and a recycling project. Furthermore JES has established 24 branches throughout the country.

Royal Society for the Conservation of Nature (RSCN)

RSCN was created in 1966 under the patronage of His Majesty late King Hussein to control illegal hunting and issue hunting licenses. Later the government expanded the responsibility of RSCN to protect the country's wildlife and wild places. Since then the mission of RSCN has expanded further to include a wide range of environmental issues and activities including promoting the sustainable use of natural resources.

To-date, RSCN has established six nature reserves covering over 1000km^2, around 1.4% of Jordan's total area and successfully bred in captivity the endangered Arabian Oryx, Gazelle and Ibex. Furthermore, they have set-up, in cooperation with the Ministry of Education, over 300 nature conservation clubs in schools to help teachers and students understand environmental issues and become involved in practical conservation projects.

Friends of the Environment Society (FOE)

FOE was formed in 1994 to enhance community development by creating an environmentally aware generation mainly by targeting students and involving them in environmental activities, and by encouraging local firms and businesses to contribute to projects aimed at supporting student environmental action.

To-date, FOE's strategy in spreading awareness has been through organizing children's nation-wide contests and competitions. FOE also participates in a dialogue program that promotes cross border dialogue amongst students of the region on regional environmental concerns and inspirations.

Jordan Royal Ecological Diving Society (JERDS)

Initiated in 1994 as a club under the umbrella of RSCN, JERDS was officially registered in 1995. JERDS is the first and only conservation organization in Jordan dedicated to marine ecosystem and the systems connected to it.

National Environment & Wildlife Society (NEWS)

Founded in 1996 by the name of Friends of Plants Society, NEWS is engaged in activities in areas concerning protection of the environment, wildlife issues and promotion of sustainable

development. NEWS publishes a monthly newsletter "Dahnoun" that documents its activities and future plans.

Water Conservation Association (WCA)

Founded in 2000 to carryout water studies and water awareness programs, as well as stimulate the implementation of policies and regulations pertaining to conserving water resources.

Center for the Study of the Built Environment

This non-profit, private study and research institution, aims to provide a better understanding of the built environment and the challenges facing it in Jordan and the region. The Center is currently implementing a program on desert landscaping.

Haya Cultural Center (HCC)

Founded in 1976, the Center is dedicated to help enhance children's perspective to culture, science and entertainment. The Center has a library, science museum, planetarium, theater, art studio and a bookshop. It also has a mobile unit that includes a science museum and a Muppet show that serves populations outside of Amman. An average of 55,000 students visit the Center annually.

Business and Professional Women Association (BPWA)

Established in 1976 to develop a comprehensive framework of structure to provide the necessary support for the empowerment and active participation of women in the social, business and economic development of the country. BPWA is a currently overseeing two water-related programs, the first is small grants to communities that are interested in enhancing their water systems and the second is to train a cadre of women entrepreneurs who will conduct home sales of appropriate Water Saving Devices (WSDs).

Precipitation and Evaporation

Climate

Jordan's climate is mainly semi-arid to arid. Only the highlands that are to the east of the Jordan Rift Valley are blessed with a Mediterranean climate, where the whether is cold and wet in winter and hot and dry in summer. In the rest of the Kingdom the temperatures are usually very high during the summer season and cold in winter.

Precipitation

The rainy season extends from October to April; the peak is usually during December, January and February. The long-term average annual precipitation is 8,500MCM of which an average of 92.5% is lost to evaporation.

Only 4% of the country's total area receives more than 300mm/year of rain. This area is comprised of the highlands. Precipitation rates decrease drastically to the east and to the west of the highlands. 71% of the total area receives less than 100mm/year.

Table 1[1] Classification by Rainfall Distribution

Classified Zone	Annual Rainfall (mm/yr)	Catchment Area (km^2)	Area Ratio %	Rainfall Volume (AD1937 – 1998) (MCM)
Semi-humid	500 – 600	620	0.7	425
Semi-arid	300 – 500	2,950	3.3	1,170
Marginal	200 – 300	2,030	2.2	530
Arid	100 – 200	20,050	22.3	2,950
Desert	< 100	64,350	71.5	3,425
Total		**90,000**	**100.0**	**8,500**

Evaporation

The high temperatures and low humidity in Jordan result in an extremely high evaporation rate. The long-term average evaporation rate is 92.5%; this ranges from 63% in the highlands to around 99% in the eastern desert.

[1] MWI database

Surface Water

Surface water resources in Jordan vary considerably from year to year. The long-term average surface water flow is estimated at 706.91MCM/year, comprising of 451.40MCM/year base flow, and 255.51MCM/year flood flow. Of these only an estimated 473MCM/year is usable or can be economically developed.

Jordan River

The surface catchment area of the Jordan River is 18,194km^2, of which 2,833km^2 lie upstream of Lake Tiberias outlet. The headwaters of the Jordan River originate from three main springs: Hasbani in Lebanon; Dan in Israel; and Banias in the Golan. The three streams join in Israel to form the Upper Jordan River, which flows into Tiberias.

Israel uses all the water of the Upper Jordan since 1962 when Israel started controlling releases from Lake Tiberias into the Jordan River and diverting water from the lake for use in Negev. Except during floods, when the lake is full, the release has been zero. Saline springs surrounding Lake Tiberias are channeled downstream of Tiberias into the Jordan River.

Downstream of Tiberias is the Lower Jordan. The major streams feeding the Lower Jordan are the Yarmouk River and Zarqa River, both join the river from the eastern side. The Yarmouk forms Jordan's northern border with Syria; the Zarqa originates solely within Jordan.

The discharge of the Yarmouk River in the Jordan River prior to the use of water by the different riparians, was around 400MCM/year. Recently, this amount has gradually declined to very small discharges.

All the water development projects in Israel, Syria and Jordan have reduced the discharge of the Jordan River into the Dead Sea to about 250-300MCM per year only[2]. This discharge is comprised of irrigation return flow, saline spring discharges by Israel, and a small amount of runoff. The water is so poor in quality that it is usable only after desalination or under strict restrictions. No water treatment is presently provided. However, the 1994 Peace Treaty stipulates that within three years both sides should refrain from discharging into the river any water that is not suitable for unrestricted irrigation (this clause has not been abided by).

Yarmouk River

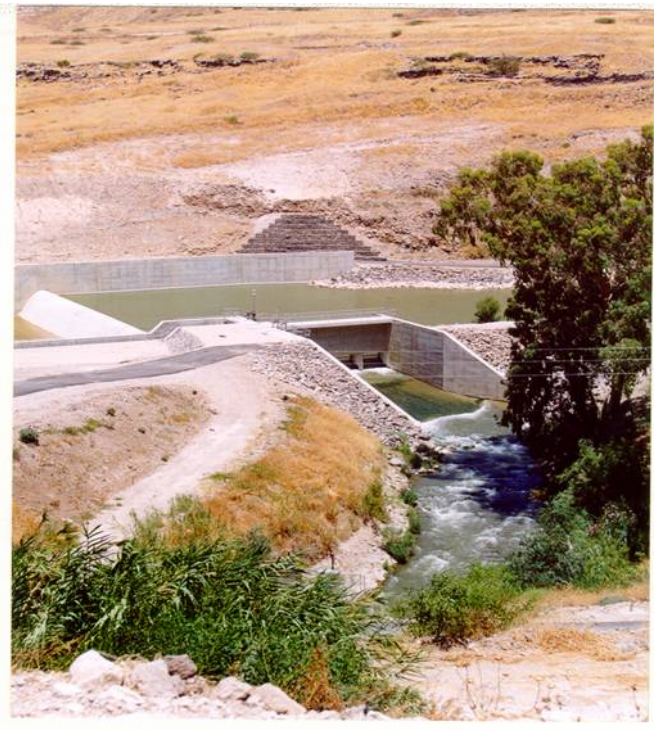
The northern portion of the river is the boundary between Jordan and Syria, and the southern portion is the boundary between Jordan and Israel. The total catchment area of the river measures 6,780km^2, 1,160km^2 lie in Jordan upstream of Adasiya, and the rest within Syria and in the Jordan River area downstream of Adasiya. The area is mostly agrarian, with some small industries located in the main towns. During floods, small amounts of wastewater runoff reach the river.

The average annual rainfall over the catchment area is 372mm/year. Precipitation is sometimes in the form of snow. During the last five decades there was a noted decrease in precipitation, the

[2] Salameh and Bannayan, 1993.

decrease averaged 30%. The long-term average total flow of the river is 355MCM/yr. Comprising of 246MCM base flow and 109MCM flood flow.

Syria extracts 160-170MCM/year from the Yarmouk River and nothing from the Upper Jordan River. Jordan historically extracted 100-110MCM/year from the Yarmouk River by diverting the water into King Abdullah Canal. The October 1994 Peace Agreement with Israel, indicates that Jordan will: divert 105MCM/year from the Yarmouk River; store 20MCM/year in Tiberias during the winter season; receive 50MCM/year of water supply from Israel; and get 10MCM/year from desalinated springs, while Israel will get 25MCM/yr. from the Yarmouk.



The water of the Yarmouk River is of good quality with total dissolved solids in the 400-800ppm range[3].

Figure 1.6

Adasiya Diversion Dam, built in 1998-99 to divert water from the Yarmouk River to King Abdullah Canal.

Zarka River

The catchment area of this river measures 4,025km^2 and receives an average annual precipitation of 237mm/year. After the Yarmouk River, this river provides the second largest surface water supply for Jordan.

The river consists of two main branches; Wadi Dhuliel, the eastern part; and Seil-Zarka, the western part. Both meet at Sukhna to form the Zarqa River. Eastern branch drains only flood flows, while the western branch drains both flood and base flows.

The catchment area for the Zarqa River is the most densely populated area in Jordan, it comprises around 65% of the country's population, and 80% of its industries. Some agricultural activities takes place in the catchment as well.

The river is augmented by sewerage effluent from As-Samra wastewater treatment plant, and other smaller treatment plants such as Ba'qa and Jerash. Most industries in the catchment discharge their effluents into the surface water system after they treat it. However, there have been numerous reports that these industries are not abiding by the discharge specifications, and

[3] JVA, 1992

the effluent discharged is not treated to the required standard. The river is controlled by the King Talal Reservoir.

Because large quantities of sewerage and industrial effluent enter the Zarqa River, water quality becomes a concern. The ratio of treated wastewater to fresh water in King Talal Reservoir ranges from 45-50% wastewater in the winter to 55-60% in the summer. Zarka River water is used principally for irrigation and stock watering.

Lesser Catchments and Wadis

Wadis in the Jordan River Area

Wadi El-Arab catchment area borders the Yarmouk catchment and measures around 246km^2. The average amount of precipitation ranges from 500mm (Irbid highlands) to 350mm (Jordan Valley). Average discharge is 6MCM/year. Catchment area is agrarian, but as Irbid city is expanding westward this might change. A dam was constructed in 1987.

Wadi Ziqlab catchment area measures 100km^2 and extends from the Jordan Valley eastwards into the highlands. Wadi dischages 8 MCM/year, 7MCM is base flow. As catchment area is agrarian with natural forests and very little population, the water is of high quality and can be used for different purposes. A dam was constructed in 1966.

Wadi Shueib catchment area is approximately 93km^2. Precipitation sometimes falls in the form of snow. The average discharges is 10MCM/year, 8MCM is the base flow. The effluent from the Salt wastewater treatment plant is discharged into the Wadi. A dam was constructed 1968.

Wadi Kafrain catchment area is approximately 159km^2. Precipitation ranges from 550 to 150mm/year. Average discharge is 15MCM/year. Different towns and villages discharge their wastes along the wadi thus affecting the water quality. A dam was constructed in 1968.

There are a number of other small wadis that discharge into the Jordan Valley. These include: Yabis, Kufranja, Jurum, Rajib, and Hisban. Precipitation on these areas ranges from 150 to 550mm/year. The base flow of these wadis is relatively small and is used for irrigation along the courses of the wadis and at the Jordan River foothills. Flood flows reach the lower stem of the Jordan River.

Dead Sea Wadis

Wadi Mujib & Wadi Hidan (Wala) catchment area is approximately 6,727km^2, it is sparsely inhabited, with moderate agricultural activity and almost no industry. Precipitation ranges from 350 to 100mm/year. Wadi Hidan joins Wadi Mujib near the Dead Sea, they discharge 65 MCM/year into the Dead Sea; half is base flow.

Wadi El-Kerak catchment area measures 19km^2. Precipitation ranges from 350-90mm/year. The catchment area is a moderately inhabited agrarian area. The effluent of Karak's wastewater treatment plant is discharged into the wadi. The lower reaches of the wadi are rich in springs and water seepage's from the sandstone aquifers. The wadi discharges 7MCM/year to the Dead Sea, 6MCM is base flow. The water is used for irrigation.

Wadi Zarka Ma'in catchment area is 269km^2. Precipitation ranges from 350mm/year to 100. The wadi discharges 20MCM/year into the Dead Sea, 17MCM is base flow. Base flow is principally thermal springs in the area of the Hammamat Ma'in Spa. The water is brackish (EC 2780 US/cm), but can be used for salt-tolerant crops.

Figure 1.7
Hamamat Ma'in springs stream just before it discharges into the Dead Sea.

Wadi Hasa catchment area is approximately 2,603km^2, it is sparsely populated with no industries and very low agricultural activities. Precipitation ranges from 300 to 90mm/year. The average discharge of the wadi is 3MCM/year most of which is seepage and springs. Some of these springs are mineralized thermal springs. A small spa has been constructed at Wadi Afra (tributary).

There are numerous other thermal springs in the Dead Sea area discharging an average annual flow of 30MCM. Water from these springs can be used in irrigating semi-salt-tolerant crops.

Wadi Araba Catchments

Northern Wadi Araba: catchment area is approximately 2,953km^2. Precipitation ranges from 300 to 100mm/year. Different wadis drain into the northern Wadi Araba, the main ones are Fifa, Khuneizerh, Fidan, and Bweirdh. The average annual discharge is about 11MCM most of it base flow. Domestic wastewater of Tafila discharges into Wadi Fifa.

Southern Wadi Araba: catchment area measures 3,742 km^2. Precipitation levels range from 150 to 50mm/year, hence, the area is barren with very low population density. The Wadi discharges about 10MCM/year into the Red Sea. The Aqaba wastewater treatment plant discharges to the aquifer underlying the catchment.

Azraq Basin: catchment area measures 13,173 km^2 and extends in the north beyond the borders of Jordan. The average precipitation is 90mm/year. Before the development of the water resources of the basin for use in the capital, the total discharge was 22MCM/year. The catchment is sparsely populated with some industries. The surface water quality is excellent, but as soon as it mixes with the water in the Oasis it becomes saline.

There are several other minor catchments such as: Wadi Yutum in the southwest (discharges 1.5MCM/year); Jafr Basin in the south (discharges 15MCM/year); and Hammad Basin spanning Jordan, Syria, Iraq, and Saudi Arabia (discharges 5MCM/year).

Dams in Jordan

Existing Dams

King Talal Reservoir (KTR) an earth fill dam that was commissioned in 1977 with a total capacity of 56MCM, that was raised to 89MCM in 1988. Currently, due to the accumulation of sediments, the capacity is at 75 MCM. KTR stores flood runoff from a 3700 km^2 catchment area, diversions from Qa'khanna Basin and return flow from municipal and industrial water supplied to Amman and Zarqa. The municipal and industrial effluent is around 50% of the inflow. The water is released from the dam by the JVA as needed to irrigate the middle and southern parts of the Jordan Valley. The dam includes a two unit-power house with a rated capacity of 6 MW.

Wadi Arab Dam an earth fill dam that was constructed in 1986 with a total capacity of 20MCM. Water is of good quality and is used for irrigation in the Jordan Valley, and for domestic purposes after filtration and chlorination. Effluent from the wastewater treatment plant for Irbid bypasses the dam, but floodwaters wash out of the plant into the dam from time to time. In the last eight to ten years, natural springs discharging in to the Wadi have dried up as a result of a 20 meter drop in the groundwater table due to pumping of groundwater for use by Irbid. Currently, base flow of the Wadi is Zero, and the Dam is filled in winter with KAC water.

Ziqlab Dam a rockfill gravity dam that was constructed in 1966, with a total capacity of 4.3MCM. The water collected in the dam is of high quality and can be used for domestic and agricultural purposes.

Shueib Dam an earth fill dam that was constructed in 1968, with a capacity of 2.3MCM. In addition to base and flood flows, the dam receives irrigation return flows and effluent from the Salt wastewater treatment plant. The dam is used to recharge the groundwater.

Kafrain Dam an earth fill dam that was constructed in 1968, with a capacity of 4.8MCM, that was raised in 1996 to 8.5MCM. The dam stores water from: Wadi Kafrein, ground water wells upstream of the dam and water diverted from Wadi Hisban. Water is used for irrigation and recharge of aquifer.

Karameh Dam an earth filled dam that was completed in 1998 on Wadi Mallahah west of the town of Karameh, with a storage capacity of 55MCM. The dam will store: excess water from the King Abdullah Canal and floods from side wadis and Zarqa River downstream of the KTR. Water in the dam will be saline and will be used to irrigate saline tolerant crops in the Middle and southern Jordan Valley areas.

Highland and Desert Dams thirteen dams have been constructed in the highlands and desert with a total gross capacity of 30.15MCM. Stored water is used for livestock, irrigation and ground water recharge. Table 3 lists these dams.

Table 3 - Dams in the Highlands and Desert

Dam	Governorate	Type	Storage MCM
Sama Serhan	Mafraq	Rockfill	1.7

Ghadeer Abdyadh	Mafraq	Concrete	0.7
Borgue	Mafraq	Earthfill	1.5
Khaldiah	Mafraq	Earthfill	1.1
Deir Kahif	Mafraq	Rockfill	1.5
Sha'lan	Mafraq	Earthfill	1
Bowidah	Irbid	Concrete	0.7
Qatranah	Karak	Rockfill	2
Sultani	Karak	Rockfill	Filled with sediments
Lohfi	Zarqa	Earthfill	0.7
Abu Swanah	Zarqa	Earthfill	0.25
Rajel	Zarqa	Earthfill	3.5
Swaqa	Amman	Rockfill	2.5
Al-Jerdaneh	Ma'an	Earthfill	2.3
Ruweished	Mafraq	Earthfill	10.7

Dams Under Construction

Tannur Dam this roller compacted concrete dam will have a storage capacity of 12MCM and will control the floods of Wadi Hisa. The dam is currently in the final stages of construction. Funding was provided by the Arab Fund ($31 million).

Wala Dam this roller compacted concrete dam will have a storage capacity of 9.3MCM. the water will be used to recharge the groundwater by artificial filtration through eight wells. Funding was provided by the Arab Fund ($30 million). Construction will be completed by the end of 2002.

Mujib Dam this roller compacted concrete dam will have a storage capacity of 35MCM. Funding was provided by the Arab Fund ($64 million). Construction will be completed by the end of 2003.

Al Wehdeh Dam all technical, economic and financial feasibility studies have been completed. Funding for the dam has been secured from the Arab Fund, the Abu Dhabi Fund for Development and the Islamic Bank for Development. Pre-qualification of contractors is currently underway.

King Abdullah Canal (KAC)

A 1953-55 Master Plan for the Yarmouk and Jordan River Valleys prepared by Harza Engineering and Michael Baker Inc. recommended the development of an intensive irrigation project covering 460,000 dunums on both banks of the Jordan River Valley.

In 1957, the first stage of the construction of the Canal was initiated with the construction of the first 69km segment. At the time the Canal was called the East Ghor Canal. In 1973, construction started on the second stage, an 18km extension. The third stage was the construction of 14.5km extension for the canal; this was completed in 1988.

KAC is a concrete lined, trapezoidal, gravity-fed waterway canal with a design capacity that ranges from 20m^3/second at the intake to 2.3m^3/second at the downstream end near the Dead Sea.

The water quality in the canal north of Deir Alla intake is a blend of good quality water from the Yarmouk River, the Tiberias North Conveyor (peace water), Mukheibeh wells, Wadi Al-Arab dam and other side wadi supplies. South of Deir Allah, KAC receives KTR water that consists of flood water from the Zarqa River mixed with poor quality treated wastewater from Amman.

Figure 1.8

King Abdullah Canal. The picture shows the area near Addasiya where the peace water that comes from Israel flows into the canal.

The peace water is pumped from the KAC to Zai water treatment plant, and then to the city of Amman, for municipal and industrial use.

The construction of the canal prompted the development of the Jordan Valley from subsistence-level farming by a few nomads to a vibrant agricultural center, which drew people into the Valley thus increasing its inhabitants.

Ground Water Resources

Ground Water Basins

Groundwater resources amount to 54% of the water resources of Jordan. Twelve groundwater basins have been identified in Jordan, these include two fossil aquifers: Al-Disi and Al-Jafar. Some of these basins have more than one aquifer. The annual safe yield of the renewable groundwater supply is estimated to be 277MCM.

Table 4[4] Ground Water Resources in Jordan

Ground Water Basins	Safe Yield MCM/ year	Total Extraction MCM/1998	Balance MCM/ year	% of Safe Yield
Yarmouk Basin	40	55	-15	137%
Side Wadis Basin (North Jordan Valley Basin)	15	12	3	80%
Jordan Valley Basin	21	38	-17	181%
Amman-Zarqa Basin	87	138	-51	159%
Dead Sea Basin	57	85	-28	149%
Northern Wadi Araba Basin	4	4	0	100%
Southern Wadi Araba Basin	6	5	1	83%
Al Jafer Basin *(Renewable)* *(Non-Renewable)*	9 Fossil	23 -	-14	256% -
Azraq Basin	24	56	-32	233%
Al Sarhan Basin	5	1.5	3.5	30%
Al Hammad Basin	8	1.3	6.7	16%
Disi	Fossil	65	-	-

In 1998, over-draft was about 157MCM in six basins. Consequently, the water level in these basins is declining and some aquifers are showing some deterioration of their water quality due to creased salinity.

Table 5 Groundwater Overdraft in 1989, 1993 and 1998

Basins	Safe Yield	Extraction's			Overdraft		
		1989	1993	1998	1989	1993	1998
Yarmouk	40	72	67	55	32	27	15
Jordan Valley	21	40	42	38	19	21	17
Amman- Zarqa	87	156	184	138	69	96	51
Dead Sea	57	82	92	85	25	35	28
Al Jafer	9	23	20	23	14	11	14
Al Azraq	24	37	50	56	13	26	32
Total	**238**	**422**	**465**	**395**	**172**	**216**	**157**

[4] Source for tables 4, 5, 6, 7 & 8 is: MWI Database

Renewable Groundwater Resources

These are rechargeable aquifers that receive water from various sources. Recharge into groundwater can be subdivided into:

- Natural recharge from the surface, either from precipitation water or from surface runoff.
- Return flow of used water: irrigation, and wastewater.
- Subsurface inflow from adjacent groundwater aquifers.
- Artificial recharge of surface water

Recharge reflects the estimated safe yield for each basin. So far, the studies that have been conducted conclude that the safe yield for Jordan's renewable groundwater resources is 277MCM/year.

In 2000, there were around 2,449 operational groundwater wells, of these 510 are illegal. In an attempt to regulate groundwater abstraction, the government in 1994 enforced the regulation requiring all licensed well to have meters. Presently, most of the licensed wells are metered.

Nonrenewable Groundwater Resources

Nonrenewable groundwater resources or better known as fossil water, is water that has been deposited in much earlier times. It has no relation to the current hydrological cycle. Little or no water is recharged into fossil aquifers.

There are two fossil aquifers in Jordan:

- Disi aquifer in the south of Jordan is the main nonrenewable groundwater resource in Jordan. The Disi is shared between Jordan and Saudi Arabia. On the Jordanian side, Disi supplies Aqaba with 14MCM/year for municipal and industrial uses and 51MCM/year for irrigation purposes. Recent estimates indicate that an annual abstraction of 125 MCM can be supported over a 50-year period. The GOJ is considering conveying Disi water for municipal use in Amman. In Saudi Arabia, annual abstractions are estimated to exceed 700MCM/year.
- Jafer basin is the other nonrenewable groundwater resource in Jordan. This aquifer can supply Jordan with 18MCM/year, over the next 40 years.

Groundwater Quality

Groundwater quality may vary within an aquifer. In general, Jordan possesses significant groundwater resources with good quality. However, this quality is threatened by over-abstraction of the resource, pollution from human settlements with its related activities and irrigation runoffs.

Wastewater

In a water-short country such as Jordan, wastewater is an important component of the Kingdom's water resources. Fully treated wastewater is suitable for unrestricted use in agriculture and to recharge aquifers for later use.

About 80 MCM/year of wastewater is treated and discharged into various water courses or used directly for irrigation, mostly in the Jordan Valley. Currently, around 70% of the urban population is provided with sewerage services.

There are nineteen wastewater treatment plants in Jordan serving around 26 cities; many of these plants are overloaded. Moreover, industrial wastewater in Jordan is discharged into public sewers, used for gardening or dumped by vacuum trucks. Regulations concerning discharge of industrial effluent into public sewers are insufficient and need revision.

Table 9[5] – Wastewater Treatment Plants in Jordan

Treatment Plant	Type	Design Capacity (m^3/day)	Ave inflow 99 (m^3/day)	Effluent Disposal
As-Samra	WSP	68,000	166,844	local irrigation, KTD
Aqaba	WSP	9,000	8,774	local Irrigation, Palm forest
Ramtha	WSP	1,900	2,174	local irrigation
Mafraq	WSP	1,800	1,933	local irrigation
Madaba	WSP	2,000	3,609	local irrigation
Ma'an	WSP	1,600	1,738	local irrigation
Irbid (Central)	TF+AS	11,000	4,612	Jordan Valley for irrigation
Irbid (Wadi Al-Arab)	EA	21,000	5,993	Jordan Valley for irrigation
Baq'a	TF	15,000	10,284	KTD
Abu Nuseir	AS +RBC	4,000	1,411	Wadi Berein
Jeresh	EA+MP	3,500	1,603[6]	KTD
Salt	EA+MP	7,700	3,166	Wadi Shueib
Karak	TF	800	1,146	Wadi Al Karak
Tafilah	TF	1,600	815	Ghor Fifa
Kufranjah	TF	1,800	1,734	Wadi Kufranjah
Fuheis	AS	2,400	1,019	Wadi Shueib
Wadi Sir	WSP+EA	4,000	914	local irrigation
Wadi Hasan/Nueimeh	OD	1,600	-	JUST for Irrigation
Wadi Mousa	EA	3400	-	Local Irrigation

WSP Waste Stabilizing Ponds AS Activated Sludge OD Oxidation Ditch
RBC Rotating Biological Contractors TF Trickling Filter

As the volume of water used by Jordan's municipal and industrial sectors' increase, the volume of wastewater also grows. By the year 2020 the population is projected to be about 9.9 million. 65% will be provided with sewerage services generating around 237MCM/year of wastewater.

[5] Source: The Study on Water Resources Management in the HKJ, Interim Report

[6] this is the average inflow before connecting the refugee camps in Jeresh

The salinity of the wastewater effluent in Jordan is higher than normal as the average domestic consumption is low, and the treatment technology is primarily stabilization ponds which loses a portion of wastewater to evaporation. This saline effluent impacts cropping patterns in the areas using the effluent. Also, it requires special irrigation techniques for many agricultural products.

The As-Samra, Wadi Mousa, Aqaba and Mafraq wastewater treatment plants will be discussed in detail because of USAID's involvement in them. A brief summery will be given for the remainder of the treatment plants

As-Samra Wastewater Treatment Plant

The As-Samra Waste Stabilization Ponds (WSP) treatment plant was constructed in 1985, as a temporary facility while the Ain Ghazal Treatment Plant[7] (AGTP) was expanded. The plan was that after the reopening of AGTP, As-Samra would be used to treat only wet weather flows. However, the AGTP was converted to pretreatment facilities and a septage receiving station, and the As-Samra WSP became the sole treatment facility.

Combined sewer and cesspit waste is conveyed from AGTP via a steel siphon 38.6km to the As-Samra Treatment Plant. As the siphon capacity is inadequate to accommodate peak flows under dry or wet weather conditions an emergency pond was constructed at the low point of the siphon. Also the GOJ, with help from the German government, is in the final stages of constructing a new siphon with a capacity of 350,000m^3/day.

Sewage from west Zarqa and from Russeifa is pumped via the West Zarqa pumping station into the siphon. Sewage from eastern Zarqa and from Hashimiyya is pumped via the Hashimiyya pumping station directly to As-Samra.

Furthermore, the AGTP receives sewage from tanker trucks that empty the cesspits of buildings in the service area which are not connected to the sewer system. The BOD and suspended solids content of cesspit waste is much higher than that of domestic sewage.

Treatment System: Screening and grit removal are provided at the AGTP headwork's and the West Zarqa Pumping Station; screening is also provided at the Hashimiyya Pumping Station.

The WSP are designed in three parallel trains. Each train consists of two anaerobic ponds, four facultative ponds, and four maturation ponds. At the end the pond effluent is dosed with gaseous chlorine. In 1997, with USAID funding, accumulated sludge in the anaerobic ponds was removed.

Effluent Quality: The As-Samra was designed to treat 68,000m^3/day, present day flows average 170,000m^3/day. Future flows are anticipated to reach 270,000m^3/day by 2015. As a result, the biological oxygen demand (BOD) and coliform bacteria count is insufficient to meet GOJ wastewater treatment standards.

[7] The AGTP was the WWTP that catered for the city of Amman from 1969 until 1985. Before the operation of AGTP cesspits were used in Amman.

Wastewater Reuse: All of the wastewater produced at As Samra is reused by farmers along Wadi Dhuleil and in the Jordan Valley. Effluent travels down Wadi Dhuleil and the Zarqa River to the KTR. BOD levels are reduced significantly along the stretch of the river and in KTR. Wastewater in the reservoir ranges from 15% to 80%, but is projected to increase to 85-90% by the year 2025.

The coliform bacteria levels, high BOD levels and high water salinity (1100-1200mg/L) are of concern to the farmers using this effluent.

Current Status and Future Plans: USAID is providing financing for a proposed 25-year BOT contract for the design, construction and operation and maintenance of a new wastewater treatment plant to replace the existing As-Samra treatment plant. The new wastewater treatment plant will provide treatment of up to 270,000m^3 of wastewater from the Greater Amman area.

USAID will provide a grant for 50% of the construction costs, up to a maximum of $75 million, as a MWI contribution towards the construction costs of the winning bidder. The bidders will have to provide 20% equity financing for the project, with the balance of the construction costs to come from whatever commercial sources they can arrange on their own. Five consortiums have been pre-qualified for the project:

1. Infilco Degre'mont (U.S.), Morganti (U.S.) and Suez Lyonniase Des Eaux (France).
2. ABB SUSA (U.S.), U.S. Filter (U.S.), Ge'ne'rale Des Eaux (France), and Social Security Corporation (Jordan).
3. Parsons Infrastructure and Technology Group (U.S.) and Biwater (Britain).
4. CH2Mhill (U.S.) and Thames Water International.
5. Ogden Water Systems (U.S.) and Morrison Knudsen (U.S.).

The RFP for the project was issued to the five pre-qualified consortiums on March 2, 2001. The closing date for receipt of proposals is June 14, 2001. Construction completion is expected by April 2006.

Wadi Mousa Wastewater Treatment Plant

The Wadi Mousa wastewater treatment plant was put in operation in 2001. It treats the wastewater of Wadi Mousa, Taiba, B'doul and Beida through the year 2020. The wastewater conveyance system consists of 2.04km of gravity sewers.

Treatment System: The treatment plant consists of preliminary treatment, secondary treatment, a series of polishing ponds and an effluent reuse system. The average capacity of the plant is 3,400m^3/day.

Effluent Quality: The effluent produced by the plant meets WAJ treated wastewater standards for discharge into Wadis.

Wastewater Reuse: 1069 dunums are designated by WAJ for reuse of the wastewater effluent. Required infrastructure for the reuse area was funded by USAID as part of the construction of the wastewater treatment plant.

Aqaba Wastewater Treatment Plant

USAID partially financed the construction of the Aqaba wastewater treatment plant that was put in operation in 1987. The project was planned for two stages which when completed will provide wastewater services to an ultimate Aqaba population of 82,000. Stage 1, which was constructed, provides wastewater collection and treatment for the city of Aqaba for a population of 60,000. As the plant is nearing its full capacity, construction of stage II is proceeding.

Treatment System: The treatment plant utilizes the WSP pond process to provide secondary treatment of up to 9,000m^3/day of wastewater. The heart of the treatment plant is a dual series of "facultative" and "maturation" ponds. Also included in the treatment plant are a series of inlet works, a re-circulation pumping station, pumping facilities to an irrigation system; and an effluent disposal lagoon.

Effluent Quality: The effluent produced by the plant meets WAJ treated wastewater standards for discharge into Wadis. Furthermore, groundwater-monitoring wells in the recharge area confirm that groundwater quality is similar to baseline quality.

Wastewater Reuse: The effluent of the Aqaba wastewater treatment plant is utilized to irrigate a belt of trees around the treatment plant sites and a palm tree garden near the plant.

Current Status and Future Plans: As the wastewater treatment plant is nearing its full design capacity, USAID is currently funding the engineering design for expanding it. USAID anticipates awarding the construction contract in the 4th quarter of 2001. This will provide high quality reclaimed water for reuse and will protect the Gulf of Aqaba from sewage pollution from the Jordanian side.

Mafraq Wastewater Treatment Plant

This WSP system came into operation in 1988 and has a design capacity of 1,800m^3/day. The plant serves the city of Mafraq; a population of 21,000. It is currently overloaded. The effluent is used to irrigate a 20-hectare nearby forest, in addition to olive and fodder irrigation.

Treatment System: The treatment plant utilizes the WSP process. It consists of two treatment trains with ten ponds starting with aerobic stabilization ponds followed by facultative and polishing ponds. A chlorination raceway is located at the end of the plant. The total land area is 37 Ha including plant lagoons.

Effluent Quality: The current influent flow (in excess of 2,000 cu. m/day) is in excess of the initial design (1,850 cu. m/day) and has been in excess of design for the past 4 years. The plant does not meet Jordanian standards for discharge into Wadis and has never achieved the effluent quality anticipated by the designers.

Wastewater Reuse: Since 1996 the treated effluent has been used by a local farmer inside the boundary of the site to irrigate 24 hectares of olive trees and animal fodder in addition to a nearby 20 hectare forest

Current Status and Future Plans: With USAID funding, CH2M Hill has complete a Treated Wastewater Reuse Feasibility and Concept Design and is currently completing a Wastewater Treatment Plant Technology and Conceptual Design Study and the Environmental Assessment. USAID will consider funding the expansion of the treatment plant once sufficient funds are available.

Ramtha Wastewater Treatment Plant

This WSP system came into operation in 1987 and has a design capacity of 1,900m^3/day. The plant, which serves a population of 39,900 in the city of Ramtha, is overloaded. The effluent is used to irrigate a 40-hectare nearby forest, and for fodder irrigation. Tendering for the expansion of the treatment plant to a capacity of 5,400m^3/day began early 2001 with funding from the French government. The plan is for the expansion to be completed by 2003.

Madaba Wastewater Treatment Plant

This WSP system came into operation in 1989 and has a design capacity of 2,000m^3/day. The plant, which serves a population of 51,000 in the city of Madaba, is overloaded and pending upgrading. The effluent is used for fodder irrigation. A contract for expanding the wastewater treatment plant has been awarded with funding from the Export/Import Bank of Korea. Construction will be completed 2003.

Ma'an Wastewater Treatment Plant

This WSP system came into operation in 1989 and has a design capacity of 1,590m^3/day. The plant, which serves a population of 14,700 in the city of Ma'an, is overloaded. Part of the effluent is used to irrigate 7 hectares of olive trees; the rest is discharged into the Wadi.

Irbid Central Wastewater Treatment Plant

This trickle filter activated sludge plant came into operation in 1987 and has a design capacity of 11,000m^3/day. The plant serves a population of 46,480 in the city of Irbid. The effluent is disposed of in the Jordan Valley for irrigation purposes.

Irbid (Wadi Al-Arab) Wastewater Treatment Plant

This extended aeration, mechanical treatment plant was put into operation in 1999. It has a design capacity of 21,000 m^3/day and serves a population of 86,320 in the city of Irbid (South & West Irbid and part of North Irbid). The effluent is disposed of in the Jordan Valley for irrigation purposes.

Baq'a Wastewater Treatment Plant

This trickle filter plant came into operation in 1988 with a design capacity of 6,000m^3/day. The plant was expanded in 2000 to a capacity of 15,000 m^3/day. It serves Baqa, Swieleh, and Ain Basha. Population served is 164,000. The effluent is disposed of in KTD.

Abu Nuseir Wastewater Treatment Plant

This activated sludge plant with rotating biological contractors came into operation in 1986. The plant has a design capacity of 4,000m^3/day and serves a population of 13,800 in the city of Abu Nusier. The effluent is disposed of in Wadi Berein.

Jerash Wastewater Treatment Plant

This extended aeration, maturation ponds plant came into operation in 1983 and has a design capacity of 3,500m^3/day. The plant serves a population of 27,600 in the city of Jeresh. The effluent is disposed into KTD.

Salt Wastewater Treatment Plant

This extended aeration, maturation ponds plant came into operation in 1981 and has a design capacity of 7,700m^3/day. The plant serves a population of 41,200 in the city of Salt. The effluent is discharged in Wadi Shueib.

Karak Wastewater Treatment Plant

This trickle filter plant came into operation in 1988 and has a design capacity of 786m^3/day. The plant, which serves a population of 12,900 in the city of Karak, is overloaded. The effluent is discharged in Wadi Al Karak. Currently, with KFW funding, design is underway for the expansion of the plant to cater for the city's wastewater treatment needs until 2015.

Tafilah Wastewater Treatment Plant

This trickle filter plant came into operation in 1988 and has a design capacity of 1,600m^3/day. The plant serves a population of 12,300 in the city of Tafila. The effluent is discharged in Ghor Fifa.

Kufranjah Wastewater Treatment Plant

This trickle filter plant came into operation in 1989, and has a design capacity of 1,800m^3/day. The plant serves a population of 35,500 in Kufranjah and Ajlon. The effluent is discharged in Wadi Kufranjah. Currently, with KFW funding, design is underway for the expansion of the plant to cater for the wastewater treatment needs of Kufranjah and Ajlon until 2015.

Fuheis Wastewater Treatment Plant

This activated sludge plant came into operation in 1997, and has a design capacity of 2,400m^3/day. The plant serves a population of 10,600 in Fuheis and Mahis. The effluent is discharged in Wadi Shueib.

Wadi Sir Wastewater Treatment Plant

This waste stabilization ponds and extended aeration plant came into operation in 1997, and has a design capacity of 4,000m^3/day. The plant serves a population of 8,700 in Wadi Sir. The effluent is used for local irrigation.

Wadi Hasan/Nueimeh Wastewater Treatment Plant

This extended aeration treatment plant has a design capacity of 1,600 m^3/day and serves the villages of Nuayyima, Shatana and Kitm. The plant came into operation in March 2001. The effluent will be used for irrigation purposes at designated reuse sites within the treatment plant and the University of Science and Technology.

Water Uses

Municipal

In 1999, the water consumption of the domestic sector was approximately 231.5MCM, around 29% of total water used in the country. 79% of the water used for domestic purposes is groundwater since with the exception of the Yarmouk River water pumped to Amman, all drinking water in Jordan is groundwater (including springs).

Demand in most urban areas cannot be met during more than half the year. Consequently, water supplies are provided on an intermittent basis 8 months a year. This shortage in water supplies is aggregated by the rapid increase in population, the inefficiency of the water distribution system and the inadequate infrastructure.

The average daily supply for domestic use is 126 liters/capita/day, of these 55% is unaccounted for water. Hence, the per capita consumption is between 60 and 90 liters/day. Reducing unaccounted for water is one of the best means to augment municipal water supplies and improve the financial viability of water supply services.

Table 6[8] Ground Water and Surface Water Uses in 1999 (MCMs)

Uses	Ground Water	Surface Water	Total	%
Municipal	183	49	231	**29**
Irrigation *(treated effluent included in surface water)*	256	265	521	**65**
Industrial	35.5	2.1	37.6	**5**
Rural & Isolated Areas *(this is not usually included when people cite water uses)*	7.3	4	11.3	**1**
TOTAL	**481**	**320**	**801**	

Industrial

Industry consumes a mere 5% of the water supply. Most of this demand is in the southern three governorates. More than half the industrial use of water is the potash and phosphate industry, with much of the remainder for electrical power plants.

As Jordan's pursues rapid economic growth, tremendous growth is anticipated in the industrial sector especially with the accession to the World Trade Organization, the Free Trade Agreement with the US and the Qualified Industrial Zones (QIZ). Currently, there are 10 QIZ, four of them are not operational yet. The rest are at an average capacity of 40%. Accordingly, it is foreseen that demand for water by the industrial sector will steadily increase over the coming years.

The electricity generating plant in Aqaba, which produces about 40% of Jordan's energy, obtains water from the Aqaba municipal supply, i.e. from Disi well fields. The other major power plant is the Hussein plant in the Zarqa Basin, which generates about one third of Jordan's electricity,

[8] MWI 1998

the water in its wells requires reverse osmosis and ion exchange to produce water of adequate quality for use in cooling.

Two major development projects are planned in the future in order to meet the growing municipal and industrial demand, the Disi conveyor (100MCM/year) and the Ma'in treatment and pipeline project (45MCM/year).

Table 7 - Projected Future Water Demand (MCM)

	2005	2010	2020
Municipal	382	434	611
Industrial	81	99	146
Agricultural	858	904	890
TOTAL	***1,321***	***1,436***	***1,647***

Agricultural

Agriculture consumes about 65% of all water use. There are 52,700 irrigated hectares in the highlands and the desert area, and 31,600 irrigated hectares in the Jordan Valley and Southern Ghors. These account for about 53% of groundwater use in Jordan.

Privately managed farms in the highlands are mostly irrigated from private groundwater wells, while the irrigated area in the desert is irrigated by fossil groundwater from the Dissi aquifer. Table 6 sums up the sources of water used for irrigation.

Table 8 - Water Resources used for Irrigation

	1980	1995	1998
Surface Water	147	256	282
Groundwater	138	291	258
Recycled Wastewater	15	58	71
	300	605	611

The publicly managed irrigation system in the Jordan Valley uses mostly surface and recycled wastewater whereby irrigation water is supplied to farmers by KAC. Furthermore there are around 195 privately managed agricultural wells in the Jordan Valley and Southern Ghors. In 1997-1999, the average annual abstraction from the Jordan Valley and Southern Ghors wells, including Jordan Valley Authority wells, was approximately 25 MCM.

Water availability in Jordan is becoming scarcer, and competition between the three sectors: municipal, industrial, and agricultural, is intensifying. Reducing the existing irrigated area to save water is politically difficult, with painful social consequences. However, reducing the irrigated area is not the only option for saving water as improving on-farm water management and adopting modern technologies can save water. These two factors can reduce the amount of water used by agriculture, releasing much needed water to the municipal and industrial sector, without reducing agricultural output.

PART 2

USAID/JORDAN SO2

"IMPROVED WATER RESOURCES MANAGEMENT"

Water Resources Strategic Objective

Activities Description

The Water Resources Strategic Objective

Background

Water is the single most critical natural resource in Jordan. Industrial and agricultural growth, productivity, public health, the environment, a democratic and pluralistic society -- virtually all aspects of sustainable economic, social, and political development depend on availability of an adequate water supply.

In Jordan the lack of water is a problem, and portends a national catastrophe within the decade. Total water supply in 1999 was estimated at 801 MCM, which includes the over-pumping of aquifers. Even with over-pumping, in most Jordanian cities, residents receive water only sporadically, and domestic water consumption is very low (less than 100 liters/capita/day.)

The demand for water is expected to reach 1,321 MCM by the year 2005. Water scarcity is exacerbated by rapid population increase, inefficient water management and use, lack of adequate wastewater treatment capacity, and inappropriate pricing policies. Large-scale desalination is not yet economically feasible. Long-term solutions are likely to involve a combination of new supplies and reduced population growth. Over the short-term, the most feasible options for reducing the gap between water demand and supply are improved management of existing water resources, and improved quality of treated wastewater for reuse.

To help resolve this water crisis, the Government of Jordan and the USAID designed in 1993 the Water Quality Improvement and Conservation Project (WQIC), which later became known as the **Improved Water Resource Management Strategic Objective**. The estimated completion date for the objective is 2004, however, a few projects will run beyond 2004.

Purpose:

Water scarcity will continue to challenge Jordan's social and economic development for decades to come. The MWI, WAJ and the JVA, must address three principal development constraints in narrowing the water supply and demand gap: 1) improve public sector management of existing water resources, 2) increase water use efficiency, and 3) improve the quality of wastewater for agricultural and industrial use. The USAID program is designed to address these three critical issues.

Strategic Objective 2: Improved Water Resources Management

This Strategic Objective addresses the critical issue of inadequate water supplies in Jordan and seeks to improve water sector institutions, increase conservation including water use efficiency, and construct and improve water and wastewater infrastructure in several critical areas of Jordan.

The indicators used by USAID to measure progress in achieving this Objective include:

- Index of stronger water institutions
- Volume of fresh water made available
- Total wastewater treatment capacity available

To-date, USAID and its counterparts have made great strides toward achieving its strategic vision in improving water resource management in Jordan. Examples include:

- A reorganized Ministry that emphasizes integrated policy development and implementation. Water Strategy and Policy statements on Water Utilities Policy, Irrigation Water, Groundwater Management, and Wastewater Management were adopted in 1997-1998.
- Improved cost recovery. In October 1997, municipal water tariffs were raised considerably. In 2001, a 12% increase in the wastewater tariff was implemented.
- A new automated accrual based financial accounting system for the JVA designed, implemented and institutionalized.
- Enhanced water quantity and quality monitoring analyses through a unified management information system and an improved water quantity and quality monitoring system was established in the MWI.
- Progress in promoting Private Sector Participation (PSP) in the water sector. The GOJ has approved a BOT arrangement for the new wastewater treatment plant at As-Samra. It has also approved the concept of a management contract for the water and wastewater systems in Wadi Mousa.
- Modifications to the Zai Treatment Plant allowed the plant to operate at full capacity during the summer of 1999, a period of severe drought.
- Design and construction of a water and wastewater collection, treatment and reuse system for Wadi Mousa and the communities around Petra.
- The design study for the wastewater collection and treatment for the North Jordan Valley.
- The design for the Deir Alla-Zai pipeline that will double the raw water capacity to the Zai water treatment plant.
- Development of a water reuse plan for the Amman-Zarqa basin and the Jordan Valley.

Despite the considerable accomplishments, Jordan's water sector remains in critical condition. Water demand continues to outstrip supply. With continued population growth, the gap is widening and is producing counter-productive responses. For example, mining of groundwater supplies has produced saltwater intrusion and escalating pumping costs. Wastewater systems are overloaded in many urban areas, which threatens both groundwater supplies and human health, and diminishes prospects for agricultural re-use.

To meet long-term demand, Jordan must identify new water sources including desalination. In the short-term, water supply can be increased through improved water resources management and greater water use efficiency in both the domestic and irrigated agriculture sectors (demand management).

Intermediate Results

The Strategic Objective will be accomplished through the achievement of three Intermediate Results.

Intermediate Result 1: Stronger Water Sector Institutions

This result will strengthen the capability of the MWI and it's two executing entities WAJ and JVA to plan, monitor, implement and sustain activities in the Water Sector. Activities include:

- A water policy implementation program focused on reducing groundwater depletion and optimizing the reuse of treated wastewater.

- A technical assistance program that aims to strengthen the government's ability to develop, contract and manage major infrastructure projects and promote PSP arrangements.
- A technical assistance program that will design and implement an automated accrual based accounting system for JVA. In addition, TA was provided to help JVA in its strategic planning process.
- A nationwide water education and public information program that aims to expand public education on the water shortage situation in Jordan, and ways in which individuals and public and private sector institutions can conserve and more effectively manage scarce water resources.
- A two-year program to provide action-oriented, short-term technical and managerial training courses to Ministry staff to improve technical skills.

The indicators to be used in measuring achievement of this intermediate result are**:**

- Index of Water Policy Implementation
- Index of Management Improvements
- Index of Private Sector Participation and Cost Recovery

Intermediate Result 2: Increased Efficiency in Use of Water Resources.

This result aims at promoting efficient use of existing water resources. Activities include:

- Rehabilitation of 10 springs and wells.
- Rehabilitation and restructuring of the water network of sixteen zones in Amman thus considerably reducing unaccounted for water.
- Improvement to the Zai water treatment plant that provides water to 40% of Amman residents.
- Funding four Irrigation Advisory Service personnel for the JVA to train farmers in more efficient irrigation methods.
- The Ma'in water treatment & pipeline project.

The Indicator to be used in measuring achievement of this intermediate Result is:

- Water systems rehabilitation/constructed.

Intermediate Result 3: Improved quality of wastewater.

Wastewater is a valuable resource if properly treated. In a water scarce country such as Jordan, treated wastewater is an important supply of irrigation water and in the future is can serve as substitute for fresh water used in agriculture and industry. Accordingly, USAID's interest in wastewater treatment in Jordan is in the reuse potential. Activities include:

- Design and construction of wastewater treatment facilities at Wadi Mousa.
- Expansion of the wastewater treatment facilities in Aqaba.
- Design of wastewater facilities in the North Jordan Valley.

- Financing the construction of a new wastewater treatment plant to replace As-Samra on a BOT basis with a USAID grant component
- Expansion of the wastewater treatment facilities in Mafraq.

The indicator to be used to measure achievement of this intermediate result is:

- Wastewater treatment systems designed/constructed.

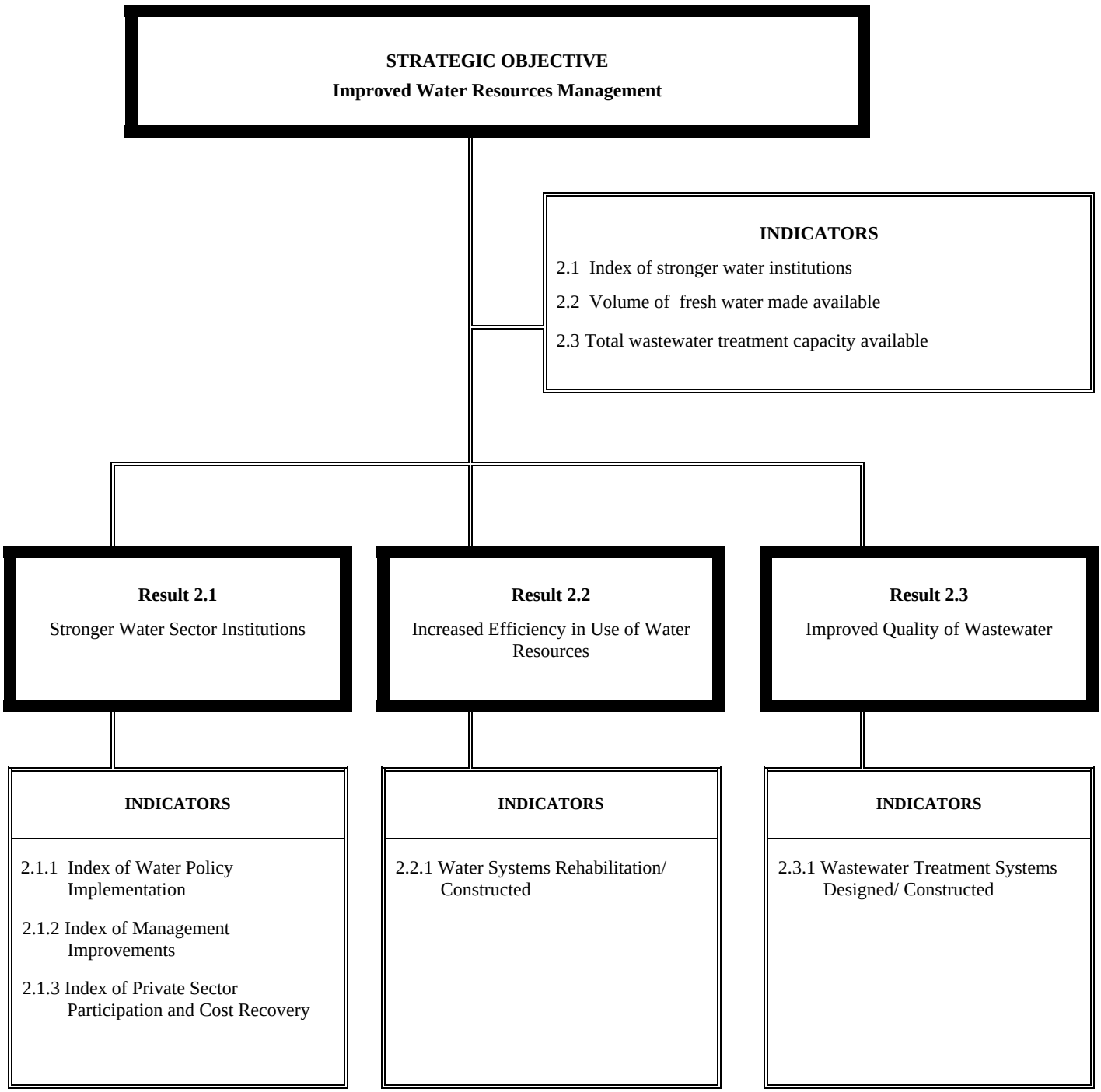
Beneficiaries, Principal Contractors, Grantees or Agencies

The direct beneficiary is primarily the MWI, WAJ and JVA. The ultimate beneficiaries are all citizens and residents of Jordan.

The principal contractors are Camp Dresser & McKee, Hazen & Sawyer, Montgomery Watson, Metcalf & Eddy, Harza Engineering, CH2Mhill, and Morganti Group Inc. for engineering and construction work. Chemonics, Associates in Rural Development (ARD), Development Alternatives Inc. and Abt Associates for technical assistance.

USAID has also awarded two Cooperative Agreements. The first to the Academy for Educational Development to implement a nationwide Water Education and Public Information program and the second to Washington State University to support MWI's human resources development plans.

Strategic Objective Indicator Table



Description of On-going Activities

HOST COUNTRY CONTRACTING (HCC) AND PRIVATE SECTOR PARTICIPATION (PSP)

Background: To meet Jordan's water and wastewater infrastructure needs $4 billion in capital investments are required over the next 10 years. This investment is vital for Jordan's continued economic growth. Funding for projects is derived from a combination of Jordanian Government, donor agencies and private financing.

Acquiring funding and improving contracting and supervision efficiency was identified by USAID and the MWI as crucial for the success of their programs. Accordingly USAID provided funding since 1998 for two separate programs one was to promote Private Sector Participation in the water sector and the other was to improve contracting and implementation of water and wastewater infrastructure projects. In 2001 it was decided to consolidate them into one program as they are closely inter-related.

Objectives: To assist MWI/WAJ establish standard efficient and transparent policies and procedures for the procurement process and project management and operations. To assist MWI/WAJ in the establishment of a well-planned PSP program, including the establishment of the necessary policy and institutional structure to assess success.

Beneficiaries: Numerous water and wastewater projects are yet to be designed and constructed. Improved contracting and management procedures are required to insure proper implementation of projects. PSP will provide an important contribution to meeting infrastructure goals and assurance of O&M. The ultimate beneficiaries are all the Jordanian people.

Schedule and Costs: This two-year activity will commence in October 2001. Estimated cost is $1,550,000. Cost of previous work was $2.93.

Partners: Chemonics.

Host Country Contracting Training Session

WATER EFFICIENCY AND PUBLIC INFORMATION FOR ACTION PROJECT

Background: The domestic water use rate in Jordan is among the lowest in the world (an average of 90 liters per capita per day). The amount of water delivered to homes barely meets requirements for basic household chores such as cooking, cleaning, and hygiene. Nonetheless, annual water consumption in Jordan still exceeds renewable supplies, and groundwater tables are being over-drafted at an alarming rate. From 1994-99, USAID funded the Jordan Environment Society public awareness program which sought to increase knowledge and improve water conservation practices among municipal and commercial/industrial users. In 1999, USAID designed a new public awareness program that was initiated in early 2000.

Objectives: To promote the use of water conservation strategies and to increase public knowledge of water issues. For example, water education curricula will be developed, religious leaders will be informed of water issues and conservation practices, media campaigns will be developed to increase awareness and conservation, water saving devices will be promoted, and grass roots community action related to water issues will be generated. Local NGOs will improve their capacity to conduct public information campaigns and to effect changes in legislation and regulations.

Beneficiaries: Direct recipients of water conservation information will be women, youth, religious leaders, journalists, and others in a position to influence public opinion. Local NGOs will be strengthened.

Schedule and Costs: This three-year, $4.3 million program commenced in February 2000.

Partners: Academy for Educational Development (AED), Development Alternatives Inc (DAI), in collaboration with local NGOs.

One of several advertisements regarding the water supplement in the children's Hatem magazine that appeared in the Arabic daily newspaper Al-Ra'i

SKILLS ENHANCEMENT AND SUPPORT TO DECISION MAKERS ACTIVITY

Background: The management responsibilities of the Ministry of Water & Irrigation and its operational authorities require that staff possess a high level of technical expertise on a range of issues related to water and wastewater quality, standards, testing protocols, etc. Given advances in technology, it is important for the staff of the Ministry and the Water Authorities to stay abreast of scientific and technological approaches to water sector management.

Objectives: To support MWI's human resource development plans by providing action-oriented, short-term technical and managerial training courses in the U.S. and Jordan; to carry out one or more targeted analytical studies related to water quality.

Beneficiaries: The training will improve MWI's capacity to successfully interpret and utilize highly technical and state-of-the-art scientific approaches to water resources management.

Schedule and Cost: This is a two-year activity with an estimated cost of $1.1 million.

Partners: This program is being implemented, under a Cooperative Agreement, by Washington State University in collaboration with Purdue University, the University of South Carolina, the University of Jordan, the Jordan University for Science and Technology and the Hashemite University.

University Consortium personnel along with MWI & USAID inspecting the Ma'in springs just before the stream seeps into the Dead Sea

WATER COST ANALYSIS AND TARIFF SETTING (FORWARD PROJECT)

Background: A significant barrier to cost recovery in the water sector is the lack of data and analytical tools to determine the real cost of providing water and wastewater services in Jordan. Historically, individuals and institutions have held widely differing views on the costs associated with water supply (municipal/industrial and agricultural) and wastewater treatment. Lack of accepted accounting systems and analytical tools to determine the cost of water is responsible, in large part, for the challenges encountered in setting rates for greater cost recovery.

Objectives: To assist the water authorities in setting rates and improving cost recovery through the development of relevant data, analytical tools, and strategic plans. This includes development of cost/tariff computer models that enable managers to look at scenarios with variables including income, expenditures, employment levels, water sales, and unaccounted-for water. It also includes the design of a financial accounting system and a strategic planning process for the Jordan Valley Authority (JVA).

Beneficiaries: The two water authorities will be better able to conduct rigorous financial planning, and to set rates at a level that will recover costs more fully.

Schedule and Costs: The cost/tariff models for WAJ and JVA were completed in 1998. A customer willingness-to-pay survey was completed in 1999. A study on the impact of different water qualities in the Jordan Valley was completed in 1999 and the Ministry is currently studying a new tariff system for irrigation water. Phase I of a strategic planning process for JVA was also completed in 2000. A financial accounting system is under development for JVA, with completion scheduled by end of 2001. The cost of these activities is estimated at $4 million.

Partners: This is a highly collaborative process in which the stakeholders are supported in their planning and decision-making by professional mediators, as well as by technical experts. The consultant is DAI, through the ANE Bureau's FORWARD project.

FORWAD Collaborative Meeting

STRATEGIC PLANNING FOR THE JORDAN VALLEY AUTHORITY (PHASE II)

Background: Since its creation in 1977, Jordan Valley Authority (JVA) has been involved in all aspects of development in the valley including building roads, schools clinics etc. in addition JVA was responsible for the supply of irrigation water to farmers in the valley. JVA's original mandate is being reconsidered because of new directions in Jordan encouraging greater public sector efficiency through decentralization, private sector participation, the streamlining of procedures, and financial independence. Also, many believe that JVA's original responsibility for social development in the valley is not longer needed.

In response, JVA with USAID support initiated a number of activities including the development of a strategic plan for the Authority. This initiative was divided in two phases. The focus of phase one (launched March 2000) was to expose JVA to strategic planning concepts and approaches, build the capacity within middle and upper management in leadership and change management and assess the external and internal environment that affects JVA. The major result of Phase I is a document outlining 19 strategic issues facing the Authority.

Objectives: To facilitate the development of a strategic plan for the JVA while building its capacity in strategic planning approaches and institutionalizing the process within JVA.

Beneficiaries: The JVA and Jordan Valley inhabitants and farmers.

Schedule and Costs: the timeframe for this effort is one year. The strategic plan is expected to be finalized the first 8 months, while the later part of the year will be for instituting the Strategic Plan within JVA. The cost of this effort is estimated at US$ 866,000.

Partners: PA Consulting Group.

PROJECT MANAGEMENT UNIT (PMU) AUDITS

Background: The Water Authority of Jordan (WAJ) is undertaking the Amman Water & Sanitation Management Project with assistance from a number of donors to substantially improve the standard of water services in the Greater Amman area and to increase the efficiency of the system. The project includes a large Capital Investment Program to rehabilitate the water system and a performance-based Management Contract (MC) with a private operator to manage and maintain the entire water and wastewater systems. The MWI established a special Project Management Unit (PMU) in August 1997 for the implementation and management of the project.

Five donors, including USAID, are cooperating to restructure and rehabilitate the Amman water system under the Capital Investment Program to reduce unaccounted-for-water and allow more frequent water deliveries to customers. The joint venture firm of LEMA (Suez Lyonnaise Des Eaux/Arabtech Montgomery Watson) was contracted on July 31, 1999 to manage and administer the Amman water and wastewater systems. LEMA must meet goals established by WAJ to reduce unaccounted-for water (UFW), improve O&M and increase revenue.

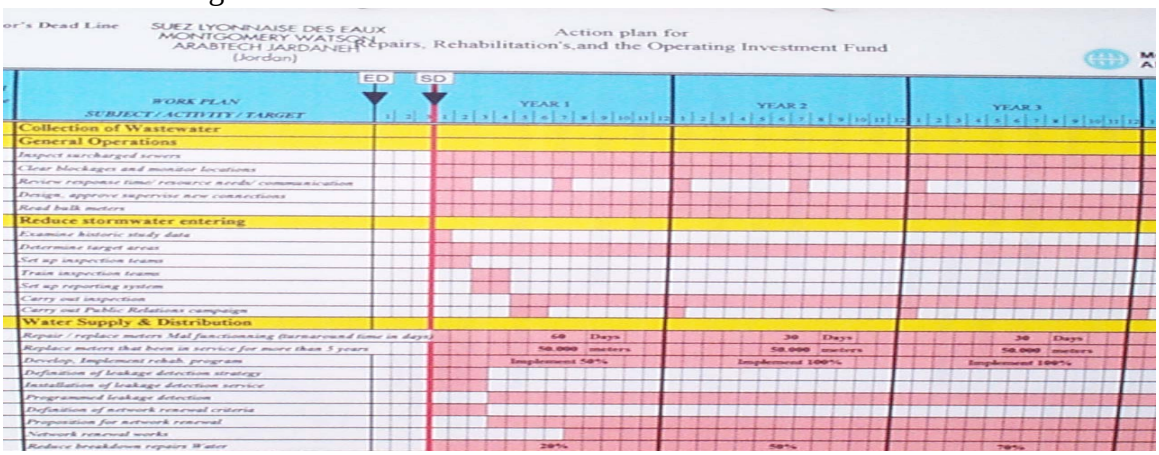
USAID contracted Abt Associates, Inc. in 2000 to provide accounting and engineering services to audit both the PMU Capital Investment Program and the Management Contract. The first audit was completed in December 2000, and the second audit was begun in April 2001.

Objectives: The objectives of the audit assistance are to assure that international accounting practices are being implemented by the PMU on the multi-donor Capital Investment program, and to assess achievement of performance targets by LEMA for progress payments.

Beneficiaries: The accounting and performance audits will improve the management and accounting of donor resources and enhance the prospects for achievement of program targets. The Amman consumers will be the ultimate beneficiaries from improved water resources management and accounting of public resources.

Schedule and Cost: This is a four-year activity with a $1.5 million estimated cost.

Partners: Abt Associates, Inc. is the primary contractor, with Arthur Anderson, Inc. providing subcontracted accounting services.



WAJ Accounting Spreadsheet

RESOURCE CITIES

Background: The problem of hazardous waste management in Jordan is escalating due to the weakness of the management and lack of expertise in the field. Proper hazardous waste management is needed to minimize the release of pollutants to the environment especially the already scarce water resources in the Kingdom. It is estimated that Jordanian industries produce more than 700 tons/yr of solid and liquid waste with a large proportion being hazardous. The typical handling method is to transport these wastes to the Suwaqa Hazardous Waste Site where it is stored pending future disposal. USAID is concerned that these wastes, if not handled properly, will ultimately create an uncontrollable problem that may eventually contaminate the ground water aquifers.

Objectives: Facilitates the exchange of teams of local government officials, city managers, mayors, and departmental heads between the U.S. and over-seas cities over a period of 18-24 months. The ultimate aim is to assist the Greater Amman Municipality to obtain the expertise needed for the proper handling and disposal of hazardous wastes generated in the municipality and disposed of at Suwaqa Hazardous Waste Disposal Site.

Beneficiaries: The Greater Amman Municipality, the General Corporation for Environmental Protection and the Jordanian population.

Schedule and Costs: 18-24 months. Total cost is US$330,950 of which USAID/Amman is contributing US$233,259.

Partners: International City /County Association (ICMA)-U.S., Greater Amman Municipality, Ministry of Water and Irrigation and the General Corporation for Environmental Protection.

IRRIGATION ADVISORY SERVICE

Background: Water use efficiency on farms in the Jordan Valley is low, particularly for drip irrigation. A 1994 study demonstrated that on-farm efficiencies were 40-50%, when 75% efficiency is expected. Technical assistance to increase on-farm water use efficiency was provided to JVA under a USAID project from 1995-97. An average of 5% increase in water use efficiency was achieved.

In 1999, an Irrigation Advisory Service (IAS) unit was established in each of the operational units of the Jordan Valley Authority (JVA) (North, Middle, and Southern Ghors, and Wadi Araba). USAID provides funding for three irrigation engineers (three years) and one economist (one year), and for the procurement of equipment. USAID also funded training materials development and an on-site training program for the IAS staff. The irrigation engineers work directly with farmers to demonstrate various techniques to decrease water use while maintaining or increasing yields.

Objectives: To increase on-farm water use efficiency by providing training and technical assistance to farmers. This includes assistance in determining the water needs of crops, as well as how to properly operate and maintain drip irrigation systems. The results of this pilot effort will be the basis for the development of a larger scale program.

Beneficiaries: Jordan Valley farmers.

Schedule and Costs: The program is funded for three years (1998-2001. The estimated cost is $233,000.

Partners: JVA and Jordan Valley farmers.

Irrigation Engineers Working with Farmers

RESTRUCTURING AND REHABILITATION OF SIXTEEN WATER DISTRIBUTION ZONES IN GREATER AMMAN

Background: The Amman water supply is insufficient to meet the normal daily needs of residents. On scheduled delivery days, selected valves are opened and water enters the system directly from large trunk lines at an extremely high pressure (≅ 5 times the optimum pressure). Because of the high pressure, water mains often break during water delivery. Accurate metering is also difficult, given the wide fluctuations in flows and pressures. Unaccounted for water in the Amman network is estimated at 54%.

Five donors are cooperating to restructure and rehabilitate the network. Preliminary system design was done by the German GTZ. In addition to USAID, assistance (loans and/or grants) is being provided by the World Bank ($55 million); European Investment Bank ($47 million); the Government of Italy ($18 million); KFW ($17 million) and the Government of Jordan ($15 million).

Objective: To reduce unaccounted-for water in the Amman water distribution network by restructuring and rehabilitating the network to modern design standards and to provide more frequent water deliveries to customers.

Beneficiaries: Customers will benefit from more frequent water deliveries. Customers will also be protected from distribution system contamination because the system will operate under pressure, thus reducing infiltration into water mains. Less water will be lost to leaks, and WAJ revenues will increase due to more accurate metering.

Schedule and Costs: The contract for final engineering design and preparation of construction tender documents for the USAID-funded portion was awarded in April 1999. Construction will take three years starting the end of 2001 at an estimated cost of $80 million.

Partners: Hazen and Sawyer is the engineering consultant and Louis Berger is the subcontractor under a host country contract with the WAJ. The construction contract IFB will be issued in May 2001.

Water Leak in Amman Street

REHABILITATION OF CONTAMINATED SPRINGS AND WELLS

Background: Residents in many parts of Jordan are on severely restricted water delivery schedules because springs and wells in their service area are unsafe to drink. Some of the sources are contaminated by cesspits and sewage leaks, while others are contaminated by naturally occurring substances such as turbidity, iron and nitrogen sulfides. Some of these communities receive water only once every two weeks.

Objective: To provide safe drinking water to customers by rehabilitating 10 contaminated springs and wells using conventional drinking water treatment plants or small "package" treatment plants.

Beneficiaries: 292,000 residents around the kingdom, as well as tourists in the Dead Sea area and the communities near the tourist facilities will have safe and adequate water supplies to drink.

Schedule and Costs: Construction of the rehabilitation of the four springs (Wadi Sir, Qairawan, Qantary and Deek) is complete. Construction of the treatment plants for three springs in Salt was completed (Nov 2001), while the construction of the three wells in Kafrein will be completed before the end of 2001. The total cost of the rehabilitation of the four springs, the three Salt springs and the three Kafrein wells is about $22.5 million.

Partners: Engineering services are provided by Camp Dresser & Mckee (CDM). Construction services for the Kafrein water supply system are provided by Hussein Atieh Establishment and for the Salt treatment plant by Morganti Group International.

Filter Units at Wadi Sir

MA'IN TREATMENT AND PIPELINE PROJECT

Background: The project originally involved collecting brackish water from Wadi Zara and Wadi Ma'in and conveying it to the King Abdullah Canal near Deir Alla. There the water was to be blended with other sources to reduce salinity, pumped to Zai Water Treatment Plant and then into the Amman distribution system. A second option was to bring the water directly to Amman from the treatment plant.

As a result of a feasibility study conducted, it was decided to proceed with an expanded second option which entails collecting the waters of Zara and Ma'in, combining them with Mujib water, treating the water to drinking water standards and pumping it up to Amman. The feasibility study concluded that this option overcame three serious problems that faced the first option: a) possibility that there may not be sufficient blending water at Deir Alla, b) Zai treatment can not reduce salinity, and c) sufficient pipeline capacity may not be available. The cost of the water delivered was estimated at less than Disi and the Red-Dead canal project alternatives.

The project is divided into two parts. Part one includes the collection systems at the Dead Sea end of the Mujib, Zara and Ma'in Wadies and pumping to a reservoir at Suwayma (financed by the Arab Fund). Part two (financed by USAID) includes the desalination and pumping of the water to Amman and the tourist hotels on the Dead Sea

Objectives: Increase the availability of low salinity potable water in Amman by bring treated water from Mujib, Zara and Ma'in Wadies along the Dead Sea up to the Amman water system (35-45MCM/yr) and supplying hotels on the Dead Sea (4 MCM).

Beneficiaries: The residents of Amman since their water supply will increase by 25-35%. The tourist hotels at the Dead Seas Shores will also benefit. The water supplied by this project is of a relatively low salinity (less than 300ppm) which will help reduce the overall salinity of the wastewater and improve irrigation reuse crop efficiency.

Schedule and Cost: Design to be completed Sept. 2001 Construction to start September 2002. Construction to be completed Nov. 2004. Total cost is estimated to be approximately $101 million, USAID $91 million and MWI $10 million.

Partners: Feasibility Study and Engineering Design by Harza. Construction will be awarded the second quarter of 2002.

WADI MOUSA WATER AND WASTEWATER PROJECT

Background: Petra is one of the premier tourist destinations in the Middle East. With peace and stability in the region, the tourist trade in Petra and the surrounding communities has grown tremendously. In the last five years, the number of hotel beds in the area has increased tenfold, from 300 beds to more than 3,000 beds. For new economic growth in the area to be sustainable, and for the local environment (and the Petra site itself) to be protected, adequate water supply and wastewater services are needed.

Objectives: To design and construct a water and wastewater collection, treatment, and reuse system for Wadi Mousa and the communities around Petra as well as design and construct a new water system. This will 1) protect the Petra site; 2) protect the local environment; 3) provide high quality water for reuse in agriculture; and 4) provide potable water to Wadi Mousa and the three surrounding communities.

Beneficiaries: Current population of 17,000 residents, plus up to 5,700 tourists a day (hotel guests and day visitors) to Petra; Jordanian tourism sector as a whole; and natural environment of the Petra area.

Schedule and Costs: Feasibility study, environmental assessments, and the final engineering design: $2.1 million, financed by USAID. Construction of the wastewater system: $27 million, of which USAID financed $22 million. Construction of the water system: $11 million, financed by the Governments of France, Germany and Jordan. Construction of water and wastewater main truck lines: $1.8 million (financed by GOJ). Construction supervision services: $3.6 million, financed by USAID. Construction of the water and wastewater facilities were completed and commissioned in November 2000. The wastewater facilities were inaugurated in April 2001. Morganti Group provided two years of hands on training on the treatment plant operation and maintenance to the Water Authority staff; USAID provided $.8 million for this effort. Total financed by USAID: $28 million of the total cost of $45 million.

Partners: CDM is the consulting engineering firm on the project ($5.7 million); Morganti Group is the main contractor on the treatment plant and pump stations contracts ($21.2 million). Six local construction firms at present are executing the water and wastewater collection contracts.

Wadi Mousa Pump Station

AQABA WASTEWATER FACILITIES EXPANSION

Background: In 1987, with USAID funding, the Aqaba wastewater treatment plant was constructed. To accommodate higher sewage flows due to increased population and commercial activity, and to provide high quality reclaimed water for reuse the plant needs to be upgraded. The project will upgrade and expand the capacity of Aqaba wastewater collection and treatment facilities from its present 9,000m^3/day to 24,000m^3/day. Treated effluent will be of high quality and will be reused in agriculture and urban applications including landscaping, parks and tourist attractions.

Objectives: To ensure adequate sewage collection, treatment, and reuse for the population and businesses in Aqaba through the year 2025. To ensure that Jordan's treaty obligations to protect the Gulf of Aqaba will continue to be met continue despite increased sewage flows in the future, and marine life is protected from sewage contamination.

Beneficiaries: Aqaba residents, commercial, tourists, industries and the marine life of the Gulf of Aqaba.

Schedule and Costs: In April 1999, WAJ awarded to Montgomery Watson (MW) of California a contract to conduct the project feasibility study, environmental assessment, and final engineering design. USAID provided $2.8 million to finance this consulting agreement. Subsequently, in 2001 a Value Engineering (VE) review of the project design was performed, recommending the construction of two adjacent treatment plants of 12,000m^3/day capacity each. One plant utilizing activated sludge technology while the other plant uses stabilization ponds. In December 2001,WAJ amended its contract with MW to incorporate the VE recommendations in the final design and tender documents, while USAID provided an additional $0.5 million to finance the contract amendment cost. Pre-qualification of US firms who will bid on the construction contract is expected to be completed in February 2002, and contract design and tender documents will be completed and issued to the qualified firms in April/May 2002. Construction completion is anticipated in the last quarter of year 2004. The Project estimated construction cost is $35 million; USAID will provide 85 % of this amount.

Partners: The consulting engineering firm is Montgomery Watson of California. A construction contractor will be selected in Sept/October 2002

Aerial View Showing Aqaba, Eilat, and the Wastewater Treatment Plant

GREATER AMMAN WASTEWATER SERVICES (As-Samra Replacement)

Background: A USAID-funded $2.8 million Greater Amman wastewater master plan completed in July 1997 identified the replacement of the existing As-Samra wastewater plant as a major priority. The As-Samra wastewater treatment plant receives more than 2.5 times the amount of sewage it was designed to treat and the quality of the effluent does not meet Jordanian standards for discharges into streams and wadis. The plant also presents a serious odor nuisance for the surrounding communities. The effluent negatively impacts the groundwater, the King Talal storage reservoir downstream of the plant and downstream irrigation re-use in the Jordan Valley.

Objectives: To ensure that greater Amman's sewage receives reliable and cost-effective treatment, protecting the environment and providing good quality water for reuse.

Beneficiaries: Residents of greater Amman will have a reliable sewage collection and treatment system. Residents of communities surrounding the As-Samra plant will experience less odor nuisance. Farmers along Wadi Dhuleil, along the Zarqa River, and in the Jordan Valley will benefit from better quality irrigation water. Groundwater will be protected from contamination with properly treated sewage effluent.

Costs: The estimated cost of a new plant is $150 million. USAID has agreed to provide grant funding of up to 50% of a Build-Own-Transfer (BOT) arrangement for a new treatment plant. The Government of Germany is providing provided $45 million for a related wastewater conveyor line to As-Samra and pretreatment system upgrades, while the Swedes are providing $7 million for the technical design/supervision services.

Partners: The Government of Germany is funding the conveyor line and pretreatment upgrades, and the Government of Sweden is financing the engineering, financial and quality assurance services for the BOT project, through completion. The private sector is expected to provide 50% of the capital costs for the new plant under the BOT arrangement (25% equity & 25% commercial loans).

LAGOONS AT EXISTING AS-SAMRA WASTEWATER TREATMENT PLANT

MAFRAQ WASTEWATER PLANT AND EFFLUENT REUSE

Background: The city of Mafraq has an existing wastewater treatment plant that is performing poorly. Furthermore the evaporation from the open lagoons during treatment increases the concentration of salts in the effluent affecting follow-on agricultural application. Currently Mafraq's partially treated wastewater is used to irrigate approximately 24 Ha. of WAJ owned land adjacent to the plant for growing animal fodder.

Reuse options for the Mafraq wastewater treatment plant (WWTP) effluent will be based on a survey of suitable economic/agricultural activities in the area. The identified reuse application(s) will determine the performance level of treatment and operating parameters for design. It is critical that any selected technology be that which addresses Jordan's needs for reuse application as well as treatment.

Objectives: To bring the reuse application into the wastewater treatment technology selection process.

Beneficiaries: The immediate beneficiaries are the 40,000 current inhabitants of Mafraq. The future beneficiaries include the 200 similar sized communities through out Jordan which are not served with wastewater collection and treatment. These communities could be a viable source of treated wastewater for agricultural or industrial application.

Costs: The initial contract work order for the assessment of reuse application and preliminary design of the treatment process will be completed by November 2001 at a cost of $844,626. Subsequently, the project will be placed on hold until funding is allocated for construction.

Partners: CH2Mhill is providing the design study. The construction contract will be awarded at a future date.

PART 3

OTHER DONOR'S ACTIVITIES IN THE WATER SECTOR

German Government (GTZ, KFW)

French Government

World Bank

European Union

Italian Government

Japanese International Cooperation Agency

United Nations Development Programme

Mediterranean Environmental Technical Assistance Program

Canadian International Development Agency

German Government

There are two agencies financing and/or implementing development projects financed by the German Government, they are:

- KFW (Kerditansalt für Wiederaufbau): this is the agency responsible for Financial Cooperation.
- GTZ: this is the agency responsible for Technical Cooperation.

KFW

KFW was created in 1948 to implement the Marshall Plan in Germany after World War II. Later it started offering financial assistance to developing countries. Under KFW there are three banks: the Export Bank, Finance Bank, and Development of East Germany Bank.

There are two KFW offices in the Middle East region. One is in Egypt, covering Egypt alone. The second, in Jordan, covers Jordan, West Bank/Gaza, and Israel. KFW finances big projects. It can finance technical services if these are part of a bigger project, or feasibility studies if they lead to financing the project itself.

KFW has been financing projects in Jordan since 1961. Money provided to Jordan by KFW are soft loans over a period of thirty years with a 2% interest rate. There is a ten year grace period. The total KFW financing for Jordan adds to about DM1.5 billion of Financial Cooperation.

On-going Projects in the Water Sector

Water Loss Reduction in Irbid and Jeresh: DM30.7 million are provided for this project. Unaccounted for water in Irbid and Jeresh exceeds 50% annually. The restructuring and rehabilitation of the water distribution network will reduce the technical losses that are due to high operation pressure and old pipelines, thus conserving the scarce water resources in the region. Pre-qualification of consultants for the design and construction supervision has been finalized and pre-qualified bidders will shortly be invited to submit their technical and financial offers.

Water Pipeline Deir Alla- Dabouq: DM 44 million are provided for this project that will increase the capacity of water transport facilities from the Jordan Valley to Amman from its current 45 MCM to 90 MCM/yr. Work was scheduled to commence in 1999, however the contract has not been awarded yet; work will continue for two years.

Amman Water Supply Two: DM63 million are provided under this project that aims to reduce the technical water losses in the Amman network by improving hydraulic conditions and repairing the urban water supply system in large parts of Amman. This is part of a larger effort supported by other donors that aims to restructure and rehabilitate the water network in Greater Amman. Civil works commend in 2001 and will be completed by 2004.

Chief Technical Advisor for the Water Supply Rehabilitation: KFW has provided DM3.5 million in grant money to support a technical advisor in the Program Management Unit (PMU) of WAJ. Lately, WAJ has requested the extension of this effort.

Irbid Wastewater Project One: In 1989 the German Government agreed to finance the wastewater plan for Irbid. However the project was so huge that available funds were not able to cover the full cost. The project was subsequently broken into two phases. Under the first phase, KFW provided DM 92.4 million to construct wastewater treatment plants in Wadi Arab and Wadi Hasa and extend the sewerage system of the city of Irbid and five surrounding villages. The treatment plants have been completed, while the construction of the sewerage system is underway.

Irbid Wastewater Project Two: under this project a treatment plant will be built in Wadi Shalala to service the western and southern western parts of Irbid. Construction will take about four years with an anticipated cost of DM123 million. The tender for consulting services is underway.

Future projects being considered:

- Water loss reduction for Karak
- Wastewater for Karak and Kufranja.

GTZ

GTZ is a private, not for profit, limited liability company, that implements technical assistance projects for the Government of Germany, primarily the Ministry of Economic Cooperation and Development. In addition, GTZ implements technical assistance projects for other governments such as the governments of Saudi Arabia and United Arab Emirates.

In Jordan, GTZ has supported projects in the areas of rural development/ agriculture, water, institutional support, public administration, and recently environmental support.

On-going Projects in the Water Sector

Operation and Maintenance Support to the WAJ/ Greater Amman: Under this project a financial accounting system was developed for Greater Amman. Furthermore, preparatory measures for the management contract in Amman were undertaken. More recent activities concentrate on the Irbid Governorate. The project is expected to continue till 2004.

Strategic Planning in the MWI: This project aims to develop a digitized water masterplan for the whole country. Using the digitized masterplan the government can map the changes as they happen as long as the information is updated in a timely and proper manner. This project will end in March 2004.

Use of Brackish Water in the Jordan Rift Valley: This project that started in 1997 aims to assess brackish springs, wells and Wadis in the Jordan Valley to see if they can be used in irrigation. Under this project guidelines for sustainable use of brackish water will be developed as well as recommendations for adequate and supportive operation of the JVA main supply system.

Improvement of Watershed Management: This project is a rural development project, which aims to improve the livelihood of rural people in the Karak area by providing the villagers with small loans to construct water harvesting wells.

Water Resources Management in Irrigated Agriculture: This project which is implemented with JVA and the MOA since May 2001 aims to improve the efficiencies of the secondary and tertiary irrigation systems (before the farm gate). This may include the creation of water user groups/associations that can play a role in the planning, operation and management of the irrigation system.

French Government

There are two types of French funds that are disbursed to the Jordanian Government:
- Funds disbursed through the Ministry of Finance.
- Funds disbursed through the Ministry of Foreign Affairs.

Funds Disbursed Through the Ministry of Finance

Allocations on the disbursement of these funds among different sectors are stipulated in the protocols signed between the French Government and the Jordanian Government. Prior to 1995, the sectors that benefited from this money were the energy, telecom, and civil aviation sectors. In the protocols of 1995, 1996 and 1998 the water sector became a prime beneficiary of the French money.

There are two types of funds disbursed by the French Ministry of Finance:

1- Soft loans. These are structured in such a way that 66% of the total amount is essentially grant money. Soft loans are used to purchase heavy equipment used in the projects. The construction part is financed by the local counterpart.

2- Grants. Grants are usually given to finance studies. Since 1997 grants are no longer allocated on a country basis. All countries receiving French aid must compete to receive grant money for conducting studies. Currently, there is one on-going study in Jordan, the feasibility study for the new solid waste landfill of Amman.

Furthermore, the French and Jordanian Governments have signed two debt-swap agreements the 1994 and 1999 agreements. The 1999 agreement was for 500 million Francs, 100 million allocated for development projects and 400 Francs to promote foreign investments in Jordan[1].

On-going Projects

Rehabilitation of the Ramtha Wastewater Treatment Plant: under the 1998 Protocol, 40 million Fancs were allocated for this project that aims to rehabilitate and expand the treatment plant in Ramtha in the north of Jordan. Originally the Korean government was going to fund this project, they completed the design and were getting ready for the construction work when economic problems in Korea forced them to cancel their involvement. Subsequently the French Government agreed to finance the project if it is executed under a performance-based contract. The design prepared by the Koreans was reviewed and updated, and WAJ prepared the solicitation documents. A performance-based contract based on the quality of the effluent was awarded in 2001; civil work will require two years.

Rehabilitation of the Ma'an Wastewater Treatment Plant: the Jordanian Government wishes to finance this project through the 1999 dept-swap agreement. The project aims to rehabilitate and expand the treatment plant in Ma'an. It is estimated that this project will cost approximately 60 million Francs and that it will be a performance-based contract.

[1] The 400 million Fancs are not restricted to French investments

Funds Disbursed Through the Ministry of Foreign Affairs

The French Government has established a Regional Mission for Water & Agriculture at the French Embassy in Amman. It is staffed with two full-time residents who's main concern is to find means to achieve substantial water saving from irrigation water. This is implemented through the Optimization of Irrigation in the Jordan Valley project (IOJoV). The IOJoV project is experimenting and demonstrating on site, at the level of a pilot-network of 131 farm-units in the Adassyeh area (north). It is assisting farmers improve their existing on-farm irrigation networks and recommending modern techniques of irrigation scheduling. Furthermore, it is assisting JVA improve the operation of the water network.

Collaboration with the Irrigation Advisory Service Unit at the JVA is a focal success factor.

World Bank

The World Bank Group is one of the world's largest sources of development assistance. It works in more than 100 developing economies with the primary focus of helping the poorest people and the poorest countries.

On-going Projects

1. Amman Water and Sanitation Management Project (AWSM): The objective of this $149.2 million project is to improve the efficiency, management, operation and delivery of water and wastewater services for the Amman Governorate. it will also lay the groundwork for a sustained involvement of the private sector in the overall management of these services.

The project consists of the a) provision of an Operator under a performance-based Management Contract (MC) to manage the water and wastewater services in Amman Governorate; b) providing the Operator with funds built into the MC for essential O&M; c) provision of finance for capital investment to rehabilitate and restructure the water supply system as well as upgrading and extending water and sewerage services in Amman; and d) TA for institutional restructuring and improving managerial capacities at WAJ as well as measures to monitor and audit the Operator's performance.

2. Disi/Amman Water Conveyor (DAWC): The project aims to provide an adequate and reliable supply of bulk water to meet the needs of M&I consumers in Greater Amman. It consists of the development of two well fields, transmission facilities (pump stations and 320 km pipeline), reservoirs, monitoring and control equipment. All facilities will be constructed and operated under a Build, Operate and Transfer (BOT) contract with a 20-year concession. with costs recovered from consumers.

The project cost is estimated at $730 million, however, the selected sponsor would be responsible for proposing the financing plan, including contingency financing on a limited recourse basis. Financing is expected from: around 25% from private equity investors; the balance from commercial bank debt under World Bank's guarantee, export credits, international financial institutions, and Government support through official loans/grants.

Aqaba Environmental Action Plan: The objective of this project is to prepare a comprehensive Environmental Management Program for the Aqaba Special Economic Zone Authority (ASEZA). The project, funded by Global Environment Fund, includes a large number of components including institutional and regulatory framework, pollution prevention and water quality monitoring, regional cooperation, geographic information system, and improvement of the Marine Park.

Middle Governorate Water Supply and Sanitation: funding for this project ($470,000) is provided by JICA. The project will assess the water supply and sanitation investments needed in the middle governorates, prioritize them and develop a policy framework.

Study to Assess Options for Regulatory Reform in the Water Sector in Jordan: $650,000 has been allocated for this study that will assess the regulatory laws in Jordan in the sector. Request for Proposals is ready and will be put out shortly.

Proposed Projects

Horticultural Export Promotion Project: This project is envisaged to promote high value agricultural export from Jordan to diversify from the volatile Gulf markets to the more stable and highly demanding European markets. The proposed project comprises of a marketing promotion/information component and a support services component (technology transfer, plant protection services, etc.)

Jordan Rift Valley Improvement Project (JRVIP): The project aims to improve the productivity of water use in the existing irrigated areas in the Jordan Valley, ensure appropriate reuse of treated marginal quality water and related environmental protection and improve sustainability of irrigation services. It consists of irrigation water management and institutional improvements as well as development of plans for reuse of marginal quality water and environmental management. The financing package consists of loans and grants through the World Bank, Global Environment Facility, and donors active in Jordan.

European Union

At the latest meeting of the Euro-Mediterranean Foreign Ministers a new MEDA financial assistance package for the EU's partners in the Mediterranean was launched. Thereafter, bilateral relations with Jordan were strengthened and new EU grant and loan agreements worth over EUR 200 million were signed in 2000. Jordan also benefits from a host of EU-funded regional actions and relief and rehabilitation programs.

On-going Projects in the Water Sector

The Amman Water Improvement Project: This EUR 5 million project signed in 2000, aims to improve efficiency, management operation, and delivery of water and wastewater services in the Greater Amman area by setting up the Project Management Unit (PMU) at the MWI. The PMU is set up as an autonomous entity supervised by an executive management board headed by the Minister and it is responsible for the follow-up of the entire Greater Amman Water Sector Improvement program.

Water Sector Intervention Project: This EUR 13.735 million project aims to rehabilitate and improve the domestic water supply in Karak and Tafilah as well as wastewater effluent re-use for Karak and Kufranje.

Rehabilitation of Drought Affected Communities in Jordan: This EUR 1.5 million project is being implemented by CARE International. It aims to help rural communities in the south of Jordan improve their overall food security situation by diversifying their food basket through planting and production intended for domestic consumption. Project activities include rehabilitation of springs, cisterns and small scale on farm irrigation systems; women revolving fund; agricultural revolving fund and rangeland demonstrations.

In addition, as an outcome of the Jordan-Israeli peace treaty the EU provided funds for conducting two studies 1) Water Storage Capacity in the Jordan River and the Jordanian Wadis; and 2) Water Conveyance between the Jordan Valley and the Population Centers in Northern Jordan (Irbid).

Euro-Mediterranean Water Information System (EMWIS)

Established in 1996, EMWIS is an information and knowledge exchange tool between the Euro-Mediterranean partners. Its objective is to provide partner countries with an instrument for collection, treatment and dissemination of information. Initially, activities will target documentation, training, research and development, institution building and data processing. Currently 4 EU countries and 9 Mediterranean partners, including Jordan, have joined the program. For additional information visit web site http://www.emwis.org.

Italian Government

Prior to the signing of the 2000-2002 Bilateral Agreement in January 2000 between the Government of Jordan and the Government of Italy, the only project funded by the Italian Government was:

The Greater Amman Rehabilitation Project: The Government of Italy (GOI) is providing approximately US$17 million for this multi donor effort that aims to reduce technical water losses in the Amman network. Tender documents were issued in 2000 and the contract was awarded to the Italian EMIT firm.

Under the new Bilateral Agreement between the GOI and the GOJ, Italy will provide approximately US$80 million of soft loan assistance and US$5 million of grant money to Jordan. A large part of this money is for the water sector as it is recognized in the agreement as a priority area. The following projects have been identified:

Construction of Three Wastewater Treatment Plants for the Camps and Surrounding Villages of Jeresh, Talbieh and Suknneh: US$22 million are allocated for this project which falls under Jordan's Social Productivity Program. The project will construct the sewer networks, household connections, pumping stations, wastewater treatment plants as well as develop a plan for effluent reuse for agriculture. Tender for the design of the wastewater system for Jeresh and Suknneh were published, and the tender documents for construction and supervision will be issued soon.

Construction of the Naur Wastewater Treatment Plant: this project is outlined in the 1997-2011 Water Sector Investment Program prepared by the MWI. US$14 million are allocated for this project under the Bilateral Agreement, the GOJ will provide an additional US$17 million under a debt swap agreement. This project is still in the formulating stage.

In addition to the above, the GOI under the bilateral agreement is financing the upgrading of the Ministry of Health laboratories as well as implementing a project that aims to environmentally improve the Zarqa landfill.

In addition, the GOI has indicated that they may be willing to finance one component of the Disi project once the financial plan is completed.

Japanese International Cooperation Agency (JICA)

The Cooperation Agreement between the Government of Jordan and the Government of Japan was signed in 1985. Assistance funds were provided through the Japanese Embassy. In 1991, JICA office opened in Amman. However, with the rising incomes in Jordan, it is expected that grant aid to Jordan will cease within the coming three years.

On-going Projects in the Water Sector

1. Improvement of Water Supply System to Greater Amman: The project aims to double the Zai treatment plant's capacity to 90 MCM/year at an approximate cost of $70 million. Construction started in mid – 1999 and completion is expected in Nov. 2001.

2. Water Resources Management Plan for the Hashemite Kingdom of Jordan: In February 2000, a study team was fielded in Jordan to carry out a two-year study that builds on the previous GTZ data bank. The plan that will be completed and presented by the end of the year.

In addition to the above, JICA is providing various equipment to the MWI i.e. leak noise correlator, leak detector, ultra sonic flow meter etc… Also, JICA annually trains 64 Jordanian staff in Japan.

United Nations Development Programme UNDP

The UNDP mission in Jordan works in four areas 1) Energy and Environment, 2) Gender and Poverty, 3) Competitiveness and Governess, and 4) Information Technology. The Environment projects include projects related to climate change, biodiversity, water resources, land degradation, solid waste management and sustainable development. Grants provided by the Global Environmental Facility[2] (GEF) must be related to climate change, biological diversity, international waters, land degradation, organic pollutants and depletion of the ozone layer.

In 1992, UNDP launched the GEF Small Grants Program (SGP). This program provides grants of up to US$50,000 to community-based activities supported by local organizations and non-governmental organizations that address one of the focal areas through providing local solutions to global issues.

On-going UN projects related to water:

Red-Dead Sea Canal: UNDP received a request by the GOJ to do specific studies regarding this mega project. Correspondingly, a task force was established based on Mr. Kofi Anan's request. UNDP is currently trying to obtain funds to implement the Environmental Impact Assessment.

Agenda 21: The national multi-disciplinary plan for action was launched in July 2001. It addresses all aspects of sustainable development and its effects on the environment, the economy and the individual. The next step will be to move the National Agenda to local agendas (municipalities and governorates). Zarqa has been selected as the first pilot city for this. A Mediterranean Environmental Technical Assistance Program (METAP) fund of US$150,000 was allocated to conduct a feasibility study for the treatment and reuse of industrial wastewater in Zarqa.

Conservation of the Red Sea Natural Resources: This project aims to conserve and preserve the natural resources of the Red Sea. Approximately US$200 million is put into this regional initiative; the UNDP and World Bank contribution is US$18 million.

On-going GEF/SGP projects related to water:

Children of the Coral Reef of Aqaba: This US$48,000 project aims to raise public awareness regarding the unique marine environment in the Gulf of Aqaba and teach the public the best means of dealing with the environment.

Rehabilitation of Biodiversity/ water Harvesting and Soil Conservation in Senfha-Tafileh: This US$17,726 project aims to enhance and disseminate sound approaches to biodiversity, soil and water conservation through rehabilitation of sloppy lands, re-introducing indigenous plant species and traditional water harvesting techniques.

Qastal Cistern Rehabilitation and Xeriscape Project: This US$37,640 project involves planting drought-resistant landscaping on site, restoring an archaeological site and rehabilitating several historical cisterns.

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[2] The GEF is jointly implemented by the UNDP, the United Nations Environment Programme (UNEP), and the World Bank.

Community Watershed Management: This US$30,000 project aims at re-introducing traditional water harvesting techniques in the community of Rakin by establishing a revolving fund for constructing the wells that collect rainwater. The project has already constructed 15 wells, and many people in the village are seeking to obtain loans for digging wells.

Improvement of Rural Community Livelihood through Sustainable Use of Biological Resources: This US$31,000 project aims at conserving biodiversity in the decreasing forest areas of Jordan as well as introducing sustainable land use practices including tree stone basins, stone terraces and rain collection wells.

Associate Ranger Program in Aqaba: This US$49,650 project will teach young volunteers (ages 16-20) similar skills to those of a Marine Park ranger including marine biology, marine conservation, swimming, snorkeling, scuba diving, park patrol, communication skills and general marine safety.

Sustained Use of Biological Resources and Improvement of Rural Livelihood: This US$16,747 project involves establishing a revolving fund which will provide funding for projects that contribute to soil conservation and sustainable land use including soil terraces, stone tree basins and construction of rain collecting cisterns.

Mediterranean Environmental Technical Assistance Program (METAP)

The Mediterranean Environmental Technical Assistance Program (METAP) was established in 1990 to bring together the Mediterranean countries to cope with, and reduce the effects of environmental degradation. METAP countries are: Jordan, West Bank/Gaza, Syria, Lebanon, Turkey, Cyprus, Egypt, Tunisia, Algeria, Morocco, Albania, Slovenia, Croatia.

This country-based approach towards improving the environment for the peoples of the Mediterranean is supported by the European Commission, the European Investment Bank, the United Nations Development Program and the World Bank.

METAP finances activities related to capacity building, arresting and controlling emerging pollution, and integrated water and coastal resources management. Currently there is only one project related to water in Jordan which is a feasibility study for the treatment of industrial wastewater in the Zarqa governorate. METAP is providing US$150,000 for this effort which will be performed by Dorch Consult.

Furthermore, financing is currently being sought by METAP for a regional water quality management project in the Mashreq and Maghreb countries. This project will aim to assist the countries improve water quality management, promote sustainable water quality information/data gathering and dissemination as well as promoting the exchange on information and experience.

Canadian International Development Agency

CIDA assistance to Jordan is focussed on two main areas: water and sanitation, and education. Currently there is only one project funded under water and sanitation, the "Integrated Jordan Valley Waste Project".

The Integrated Jordan Valley Waste Project: This Canadian $4 million project will provide a wastewater treatment plant for the Deir Alla community. Construction of the 400m^3/day wastewater treatment plant will commence late 2001/ early 2002. Collection of the wastewater will be by trucks. The uniqueness of this project is in the high-level stakeholder participation and its aim to create a system that has a potential to be profitable and lure the private sector to be involved in the operation. The project involves NGOs, the community, the government and the private sector.

PART 4

REGIONAL MATTERS RELATING TO THE WATER SECTOR

Facts About Water in the Region

Middle East Peace Process

Middle East Regional Cooperation (MERC) Projects

Facts About Water in the Region[1]

Surface Water Resources

About 975 MCM/year of surface water resources are developed and used in the region[2] originating from the four main water units:

1. Upper Jordan River
2. Lake Tiberias
3. Yarmouk River
4. Lower Jordan River.

Additional surface water resources that can be developed are approximately 225 MCM/year, thus resulting in a total renewable surface water resources of about 1,200 MCM/year. Table 10 displays the Annual Surface Water Resources Available in the Region.

Table 10 Annual Surface Water Resources Available in the Region

Sub Region	Current Surface Water Developed MCM/ year	Future Surface Water Developed MCM/ year
West of Jordan River	685	725
East of Jordan River	290	475
Total Region	975	1200

Groundwater Resources

About 1,600 MCM/year of groundwater resources (renewable and non-renewable aquifers) are currently used in the region. The largest share of about 1,234 MCM/year are used in Israel and the Palestinian Territories. 465 MCM/year are used in Jordan.

Most of the groundwater resources in the region are fully exploited and some aquifers are overexploited, particularly in Jordan and the Gaza Strip. Total exploitable groundwater resources, which includes the development of non-renewable water resources and the use of brackish water, is estimated at about 1,787 MCM/year.

The safe yield of all renewable water resources (surface and groundwater) in the region has been estimated at 2,800 MCM/year.

Wastewater Resources

Treated wastewater is becoming increasingly important in the region. Currently treated wastewater accounts for about 8% of total supplies, the largest share being mobilized in Israel.

[1] Information from "Middle East Regional Study on Water Supply and Demand Development, Regional Overview", Phase 1
[2] The region here refers to Jordan, Israel and the Palestinian territories.

Water Use and Demand

At present, 3,134 MCM of water are used in the region, exceeding the regional renewable water resources of about 2,800 MCM. Irrigation water use accounts for 66%, domestic water use for 27%, and industrial water use for 5%. Conveyance losses are reported to account for 2%.

On a region wide basis, current gross per capita domestic water use is estimated at 72m^3/year, with significant differences among the core parties. Table 11 shows the Renewable Water Resources Per Capita in the Middle East.

Table 11[3] Middle East: Water Availability

Renewable Resources Per Capita

	1960	1990	2025
Egypt	2,251	1,112	645
Israel	1,024	467	311
Syria	1,196	439	161
Jordan	529	224	91

By 2010, 4,382 MCM of water will be required, and an estimated additional 564 MCM of water have to be mobilized between 2000 and 2010.

Water Development Options

After exploiting all renewable fresh water resources within their national boundaries, Israel, the Palestinian Territories, and Jordan will have to develop transboundary waters and/or non-conventional waters.

Conventional water development options comprise further development and exploitation of the mountain aquifers, the retention of surface flows on side wadis of the Jordan River and in the Yarmouk River, the retention of winter floods in the Lower Jordan River, and the further development and exploitation of the Disi aquifer in Jordan. All these options will be implemented on a national level.

In addition to these conventional options, non-conventional waters will need to be developed to meet the regional water needs. Non-conventional options include:

* Treated wastewater. In all the core parties' areas, it is expected that treated wastewater will be an important long-term water supply for irrigated agriculture.
* Desalination of brackish water, mainly in the southern parts of Jordan, Israel, and the Jordan Rift Valley. A substantial mobilization of additional water from brackish groundwater is not

[3] Source: MENA Water Strategy

expected and possible negative effects on the hydrological system have to be carefully examined.

* Desalination of seawater. Transfer of seawater from the Red Sea to the Dead Sea for combined hydropower generation and desalination is currently being discussed by the parties. An Environmental Impact Assessment and a Feasibility Study are being discussed.
* Importing water into the region. Several alternatives for importing water to the regions have been discussed. These include:
  - Pipeline/canal for diverting surplus water from Turkey to various locations in the region.
  - Other land transport water schemes could be from Litani to Lake Tiberias, from the Nile to the Gaza Strip, and from the Euphrates
  - Importation of fresh water from Turkey by sea in large vinyl bags or in tanker.

Each of the above alternatives requires considerable investments. In addition, there are political constraints and risks involved.

Conclusions

Supplies of renewable water in the region are fully used or already overexploited, and demand will continue to rise rapidly. Accordingly, the water situation in the region is precarious.

About 43% of the renewable supplies are provided from surface water, which largely originates in areas outside the core party territories, and which are vulnerable to abstraction by upstream riparians. Claims on rivers and aquifers crossing national borders have caused conflicts within the region.

The limits on economically exploitable renewable water in the region have almost been reached. Therefore, water conservation and reallocation between sub-sectors and sub-regions will become increasingly important as the only feasible alternative to non-conventional sources.

Deteriorating water quality in the region is becoming a serious issue, and existing economically exploitable resources might become unsuitable in the future due to increasing pollution. If current trends continue, groundwater in some areas may not be adequate for human use any more.

Middle East Peace Process

Background

In 1991 Israel and Jordan joined Egypt, Syria, Lebanon and a Palestinian delegation at a conference in Madrid that launched the Middle East Peace Process.

In 1993, Jordan endorsed the peace accord between Israel and the Palestine Liberation Organization (PLO). Later, Jordan signed an agenda with Israel for future negotiations in Washington.

In 1994, Jordan and Israel signed the Jordanian-Israeli Peace Treaty on the border between Aqaba and Eilat.

Peace Treaty Between Jordan and Israel

The October 26, 1994 Jordan-Israel Peace Treaty formally ends the state of war between Israel and Jordan which existed since 1948. Likewise, the treaty binds each country:

- to recognize the sovereignty, territorial integrity and independence of the other;
- to respect one another's right "to live in peace within secure and recognized boundaries";
- to develop "good neighborly relations of cooperation".

In relation to water, the treaty addresses:

- developing water resources;
- preventing contamination or pollution of water resources;
- jointly monitoring water quality along the boundary;
- providing water of equivalent quality when exchanged between two countries;
- Prohibiting the discharge of municipal or industrial wastewater into the Yarmouk or Jordan Rivers before treatment to standards allowing unrestricted agricultural use.

Annex E provides the full body of the Peace Treaty signed between the Hashemite Kingdom of Jordan and the State of Israel. While Annex F lists the Multilateral Bodies of the Middle East Peace Process.

Middle East Regional Cooperation Projects (MERC)

The MERC program that started in 1979 as a result of the Camp David Peace Accords, funds collaborative research projects between Israel and its Arab neighbors. The goal of the program is to contribute to the Peace Process and the development in the Middle East. Jordan became an active participant in many MERC project after the peace treaty between Jordan and Israel was signed.

MERC focuses on technical issues in the areas of agriculture, health, environment, economics, and engineering. Funds are provided for grants of up to $3 million over a five year period. Awards are made based on review of technical merit and the contribution to peace and development in the region. Lately many water related projects have been approved.

For the proposal to be eligible, the project should be a bilateral or multilateral effort that Israel is a party in, regardless of the party submitting the proposal. The only non-regional partners allowed are US institutions that might provide technical assistance. For the past two years, the Mission in Jordan has participated in the review process.